

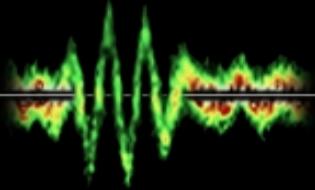
7th International HEC-DPSSL Workshop

Diode-pumped, active-mirror Yb:YAG imaging multi-pass amplification to the 1J-level - current status of the PFS CPA pump laser

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Institute of Optics and Quantum Electronics, Jena, Germany

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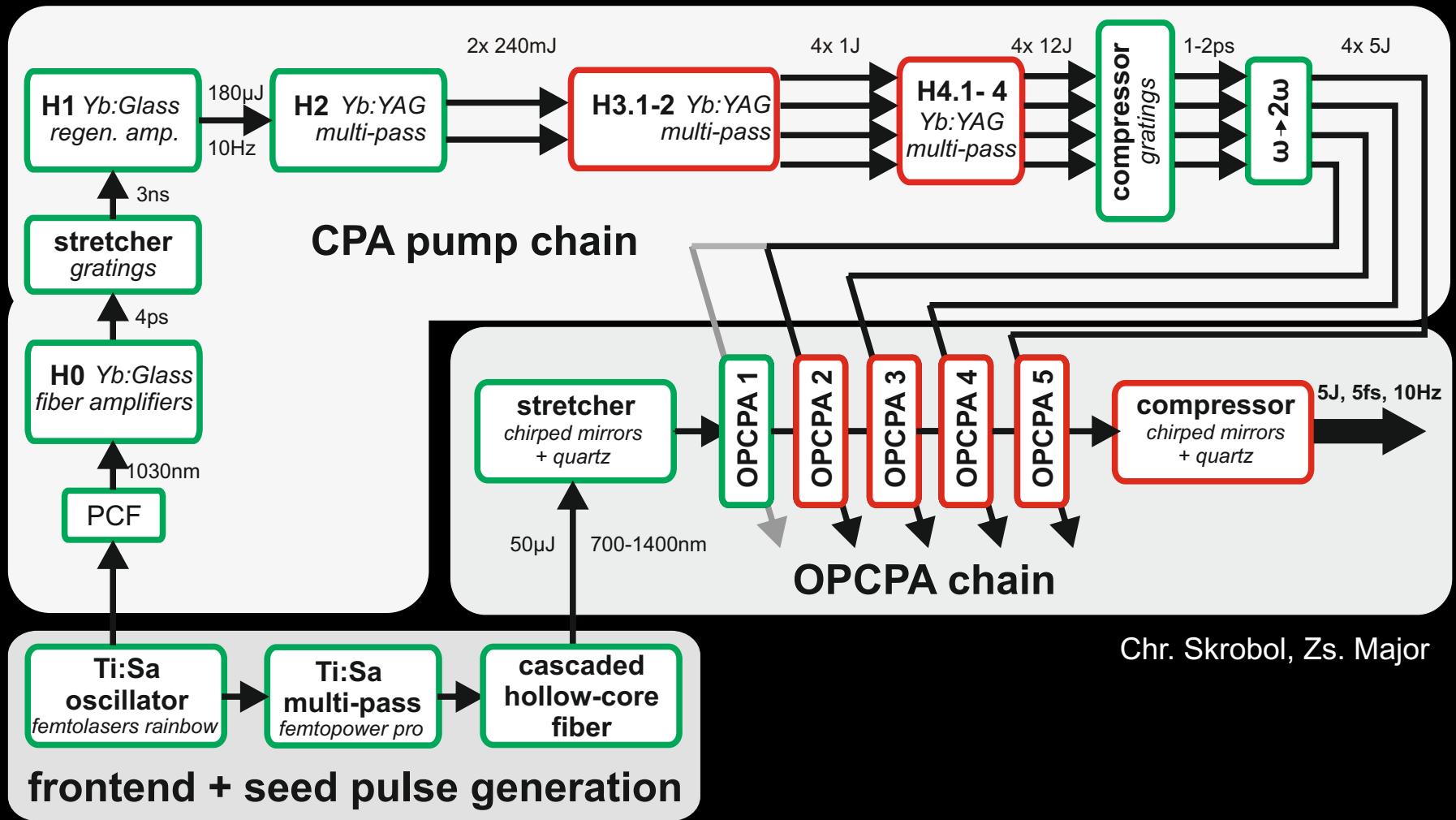


outline

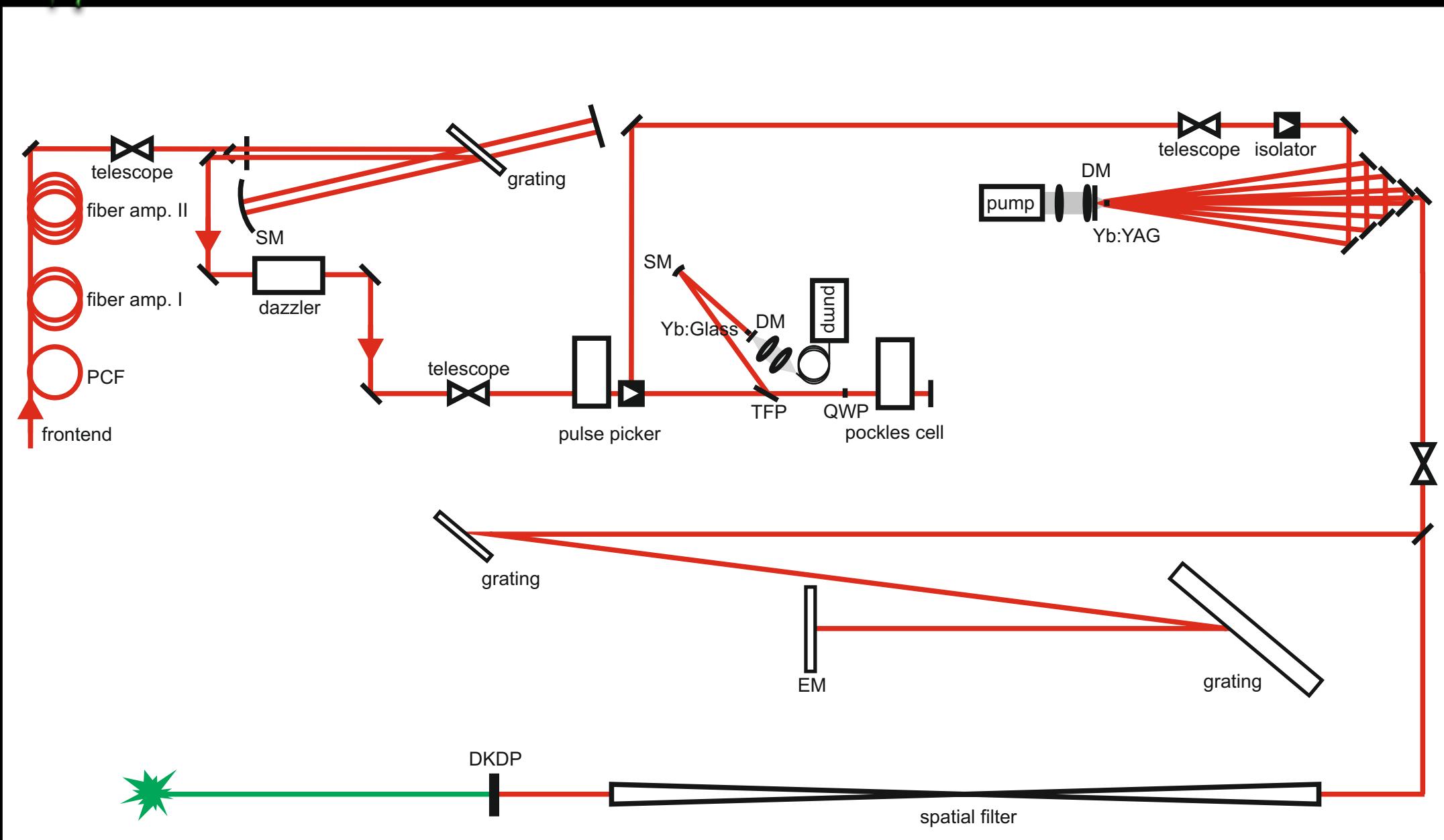
- PFS Pump scheme
- problems & conclusions
- imaging multi-pass amplifier
- first vacuum tests
- tests new crystals

overview

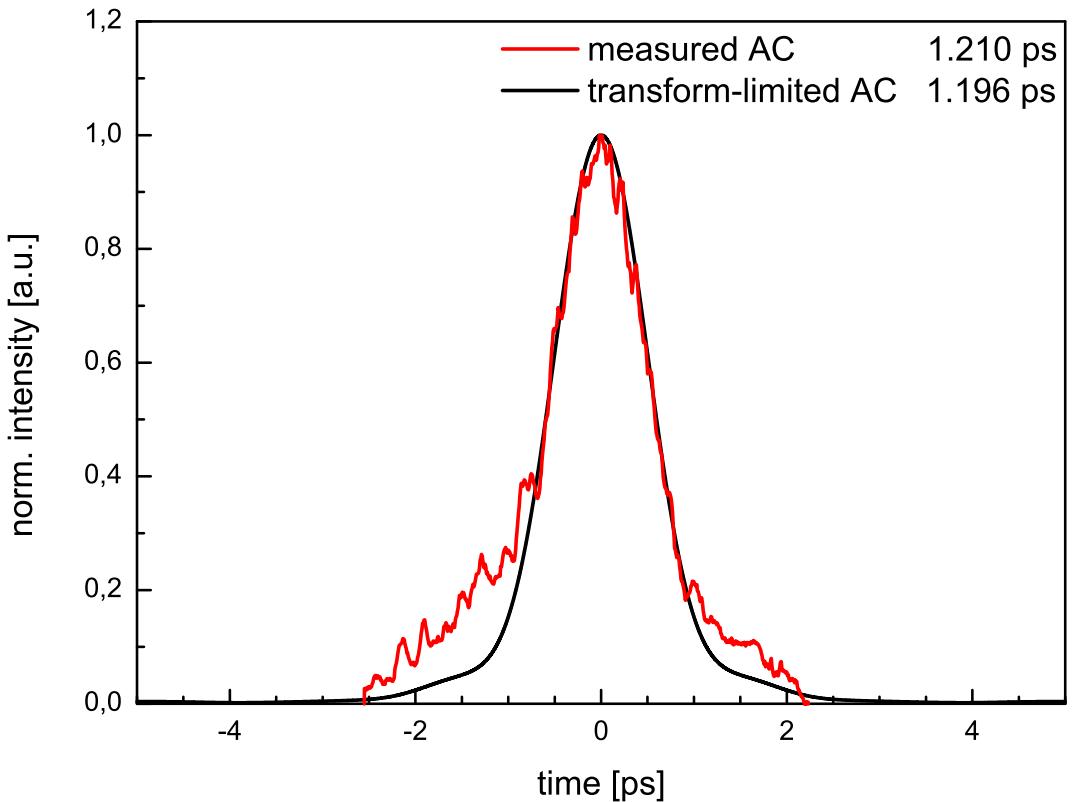
Chr. Wandt, S. Klingebiel



overview - PFS Pump scheme

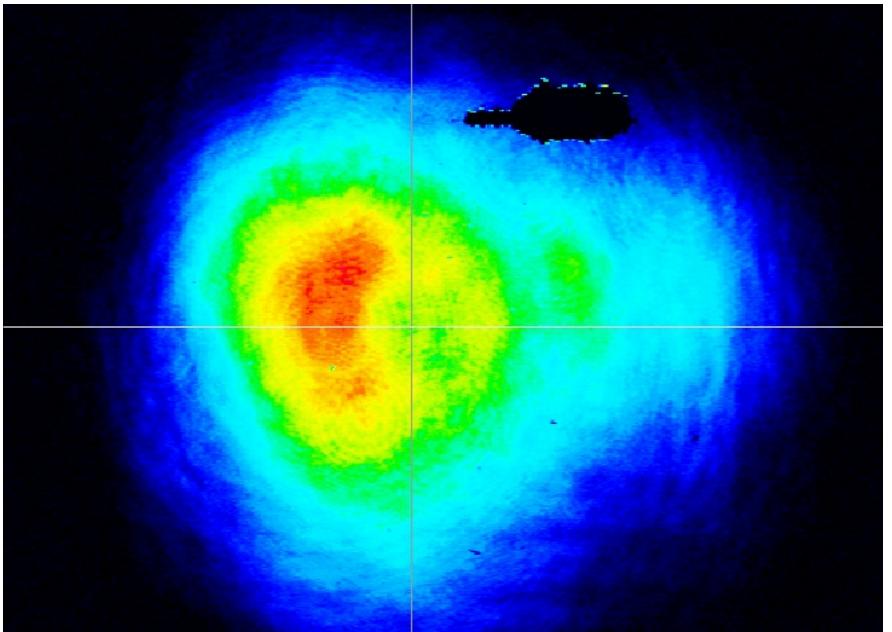


compression results



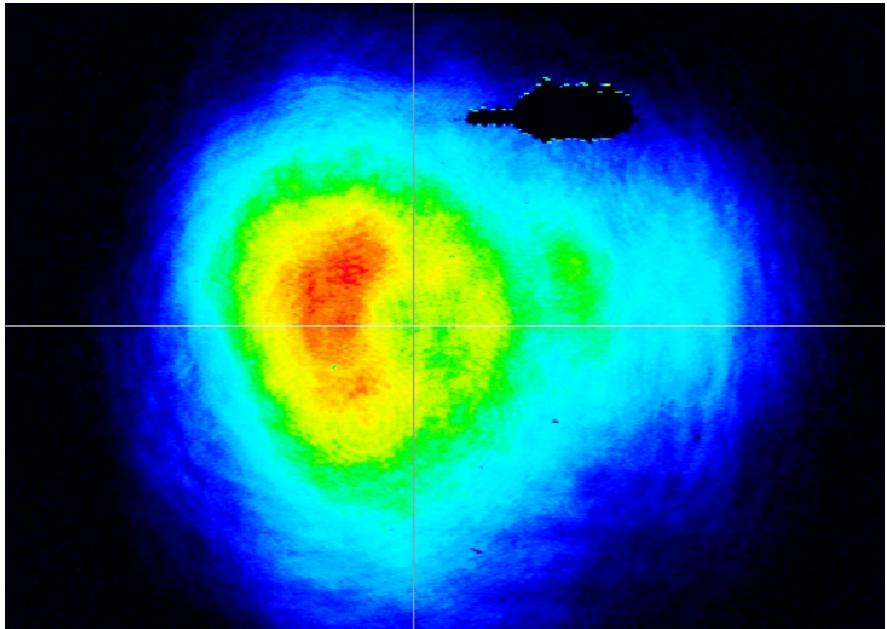
- pulse duration: 0.895 ps (FWHM)
- very stable: STD: $\pm 3\%$

compression results

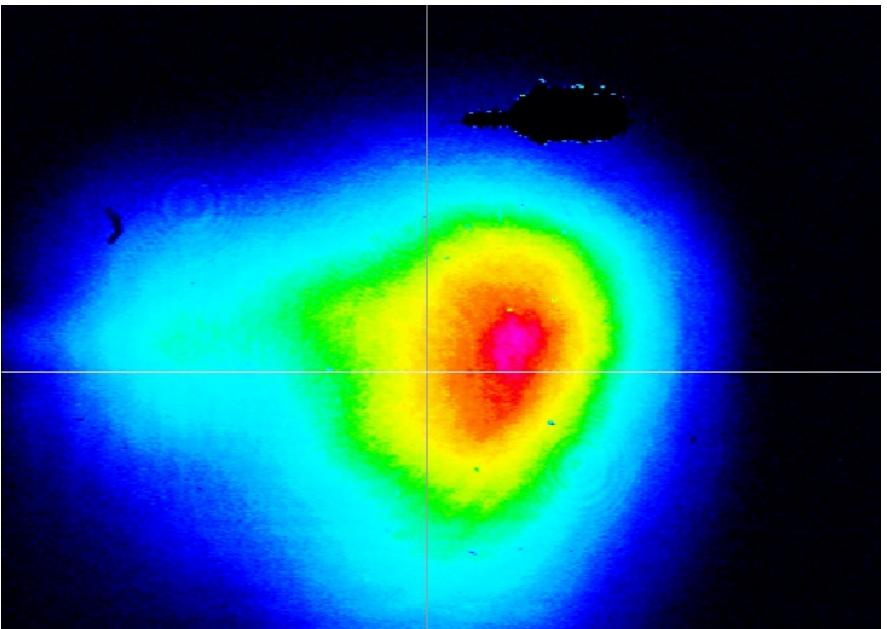


beam profile out of compressor

compression & doubling results

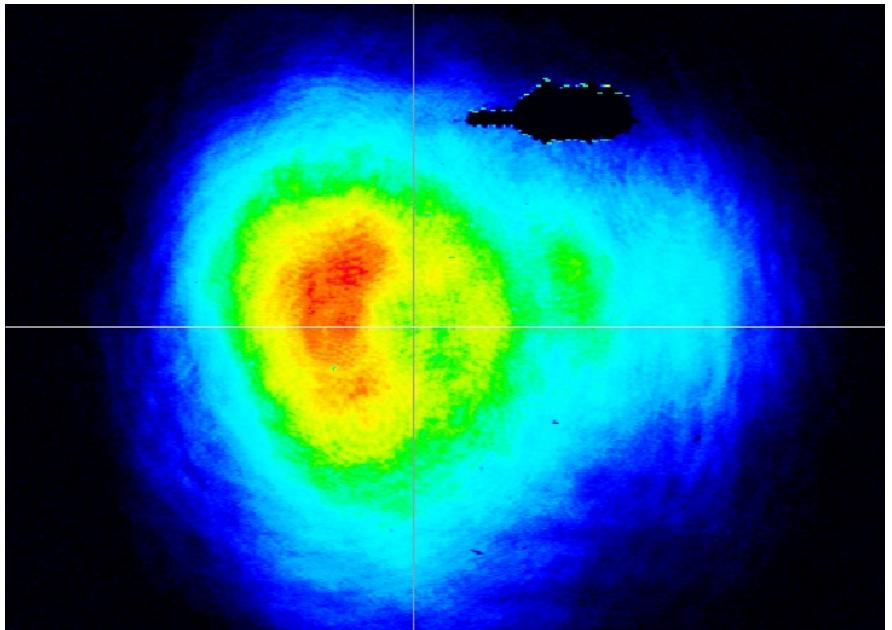


beam profile out of compressor

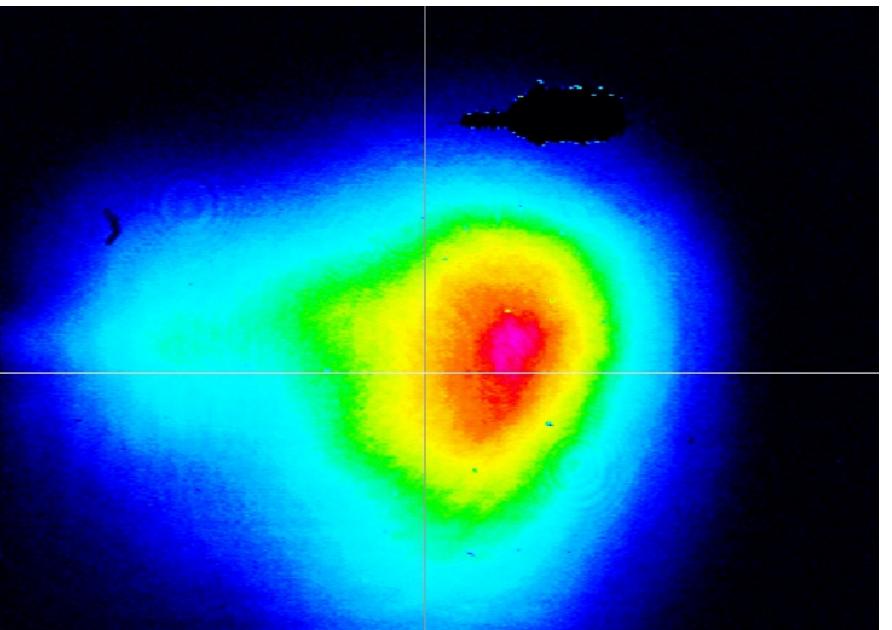


beam profile after spatial filter and doubling

compressor + doubling

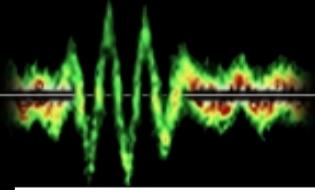


beam profile out of compressor

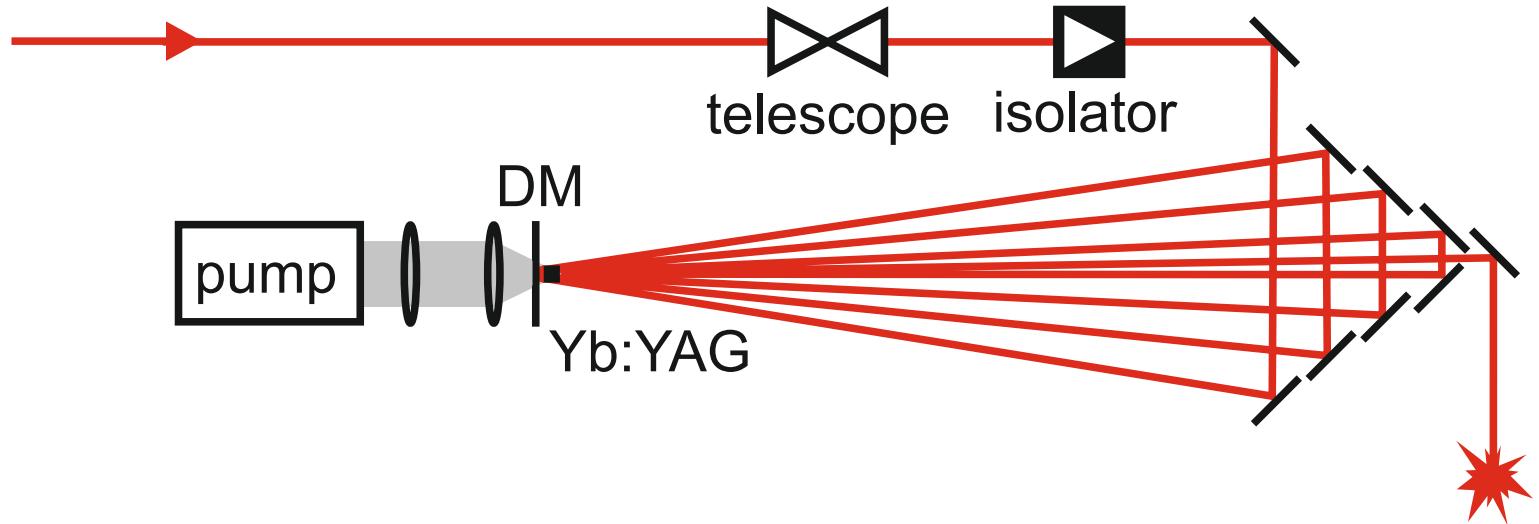


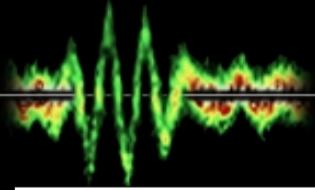
beam profile after spatial filter and doubling

- throughput compressor: 200mJ, 66% efficiency
- throughput spatial filter: 180mJ, 90% efficiency
- frequency doubling in DKDP: 72mJ, 40% efficiency

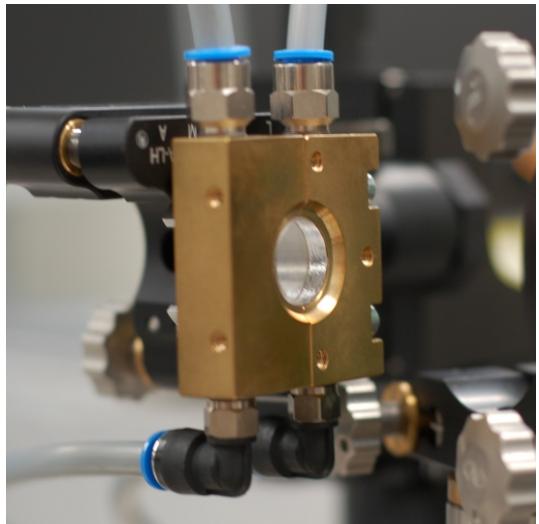
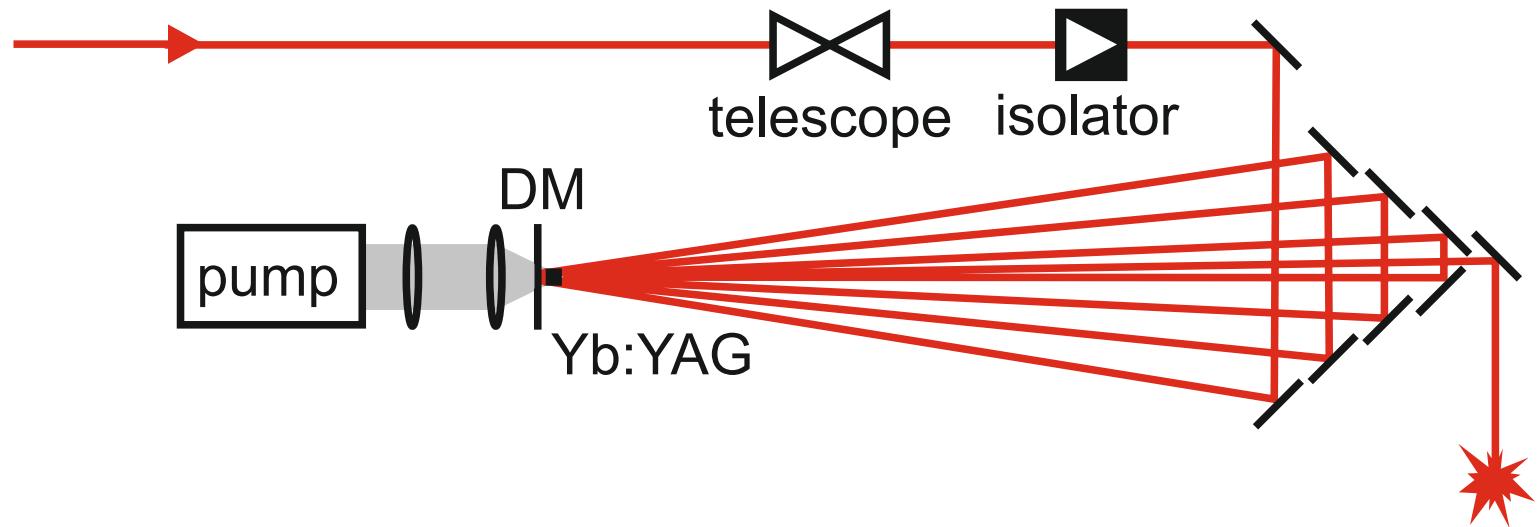


problems identified

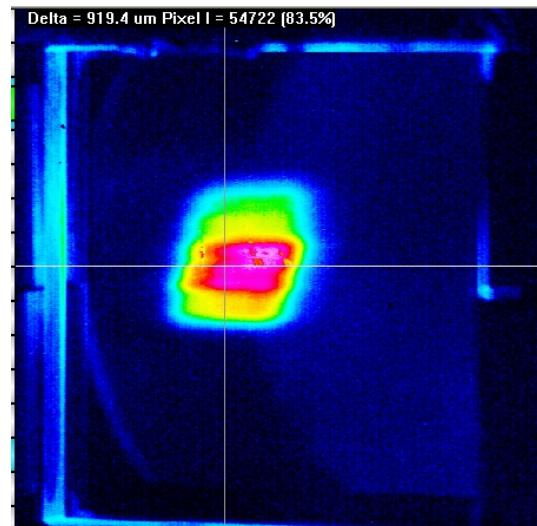
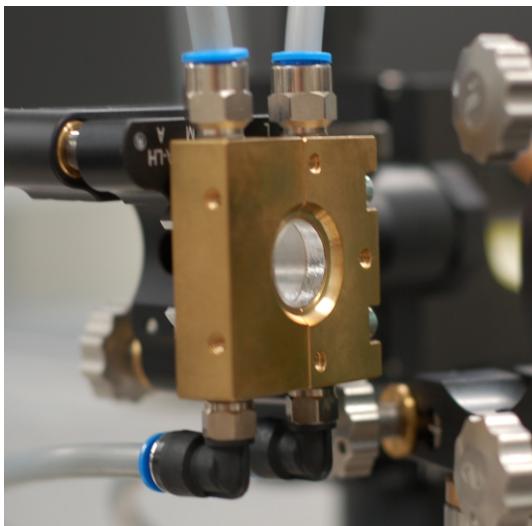
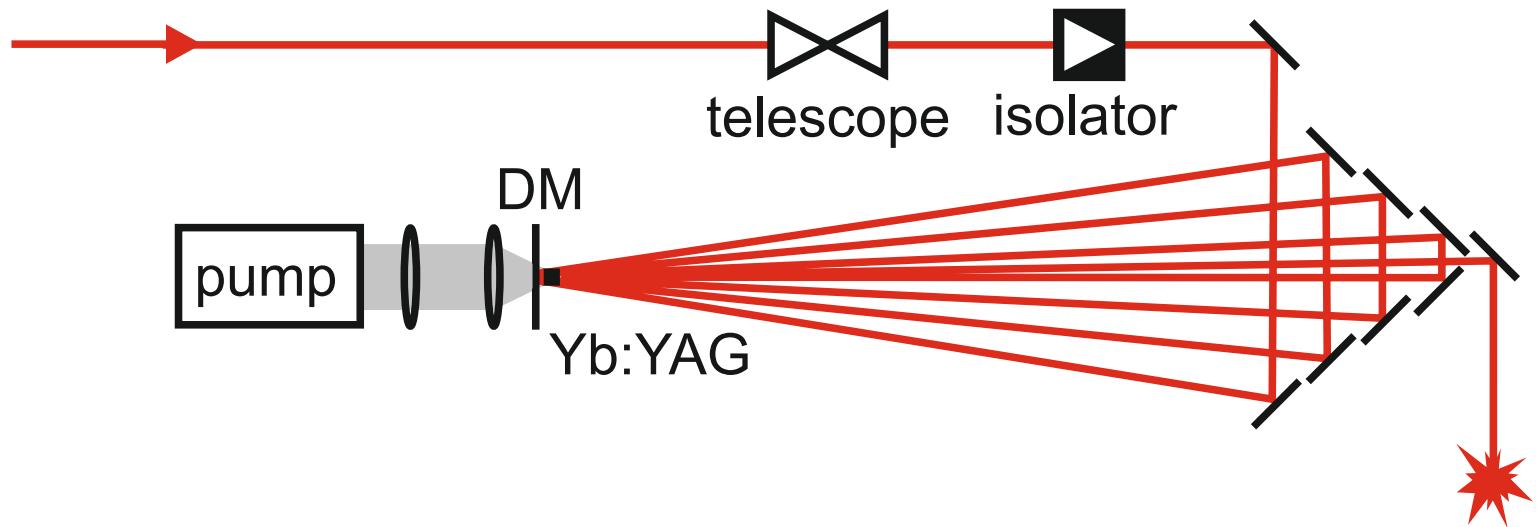


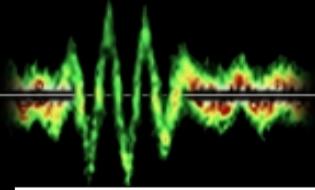


problems identified

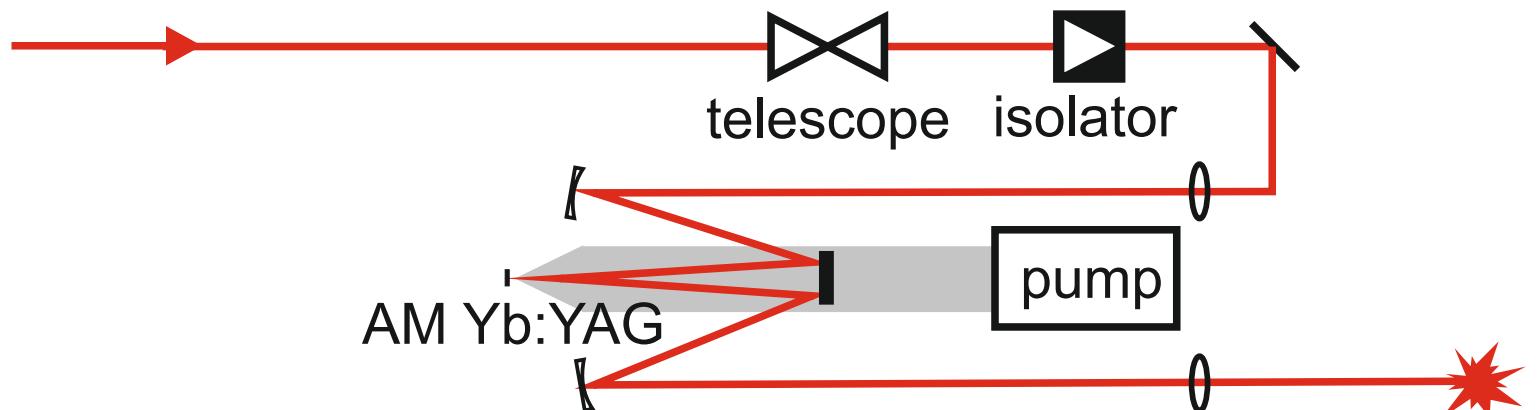
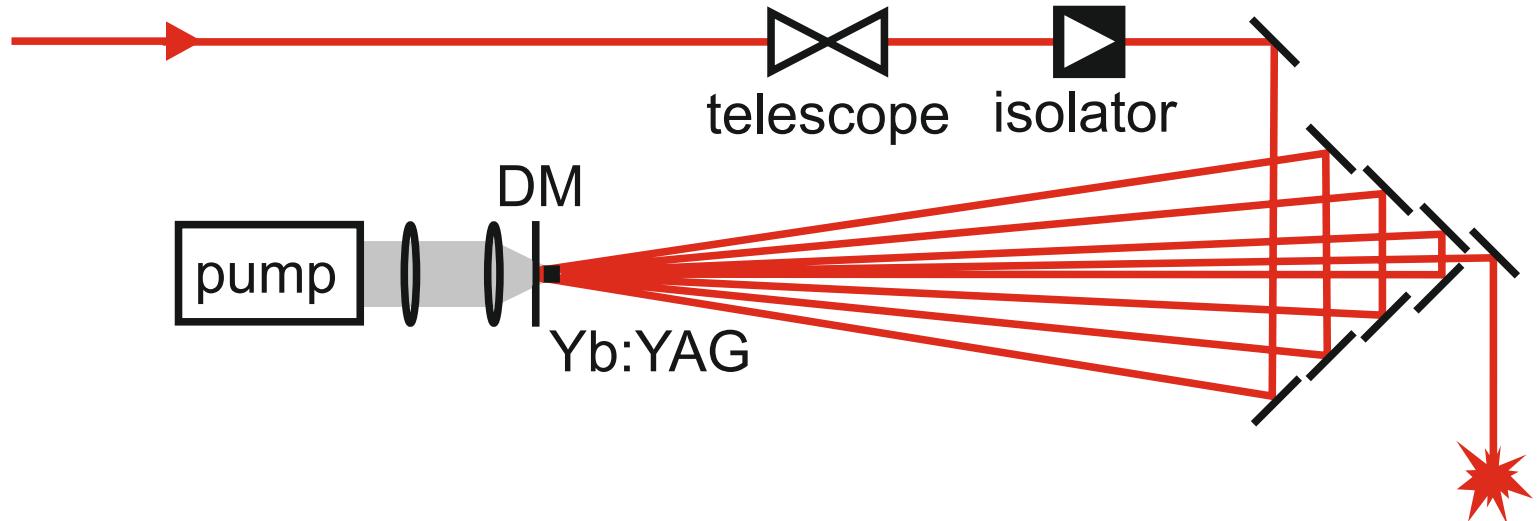


problems identified





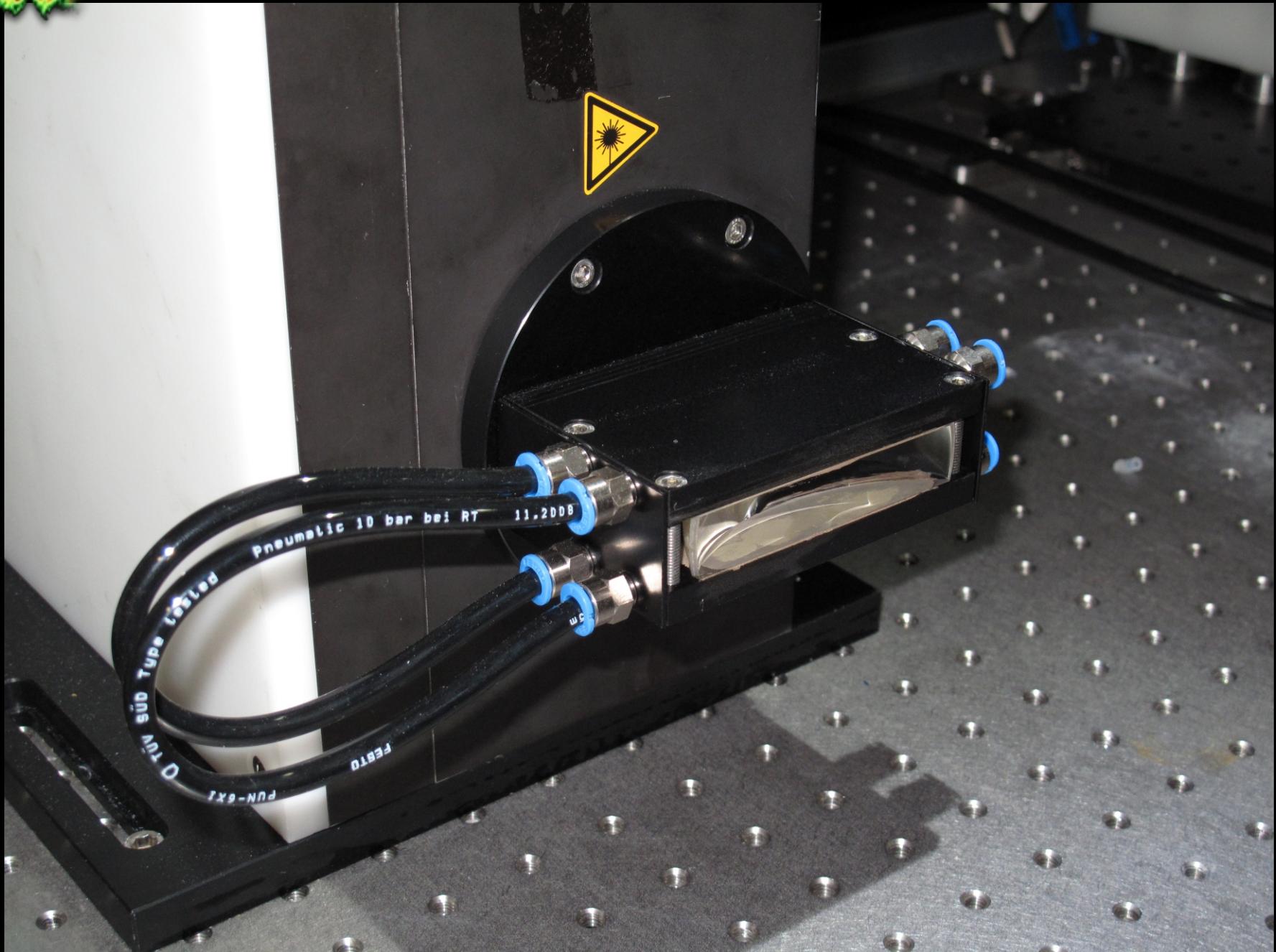
problems identified



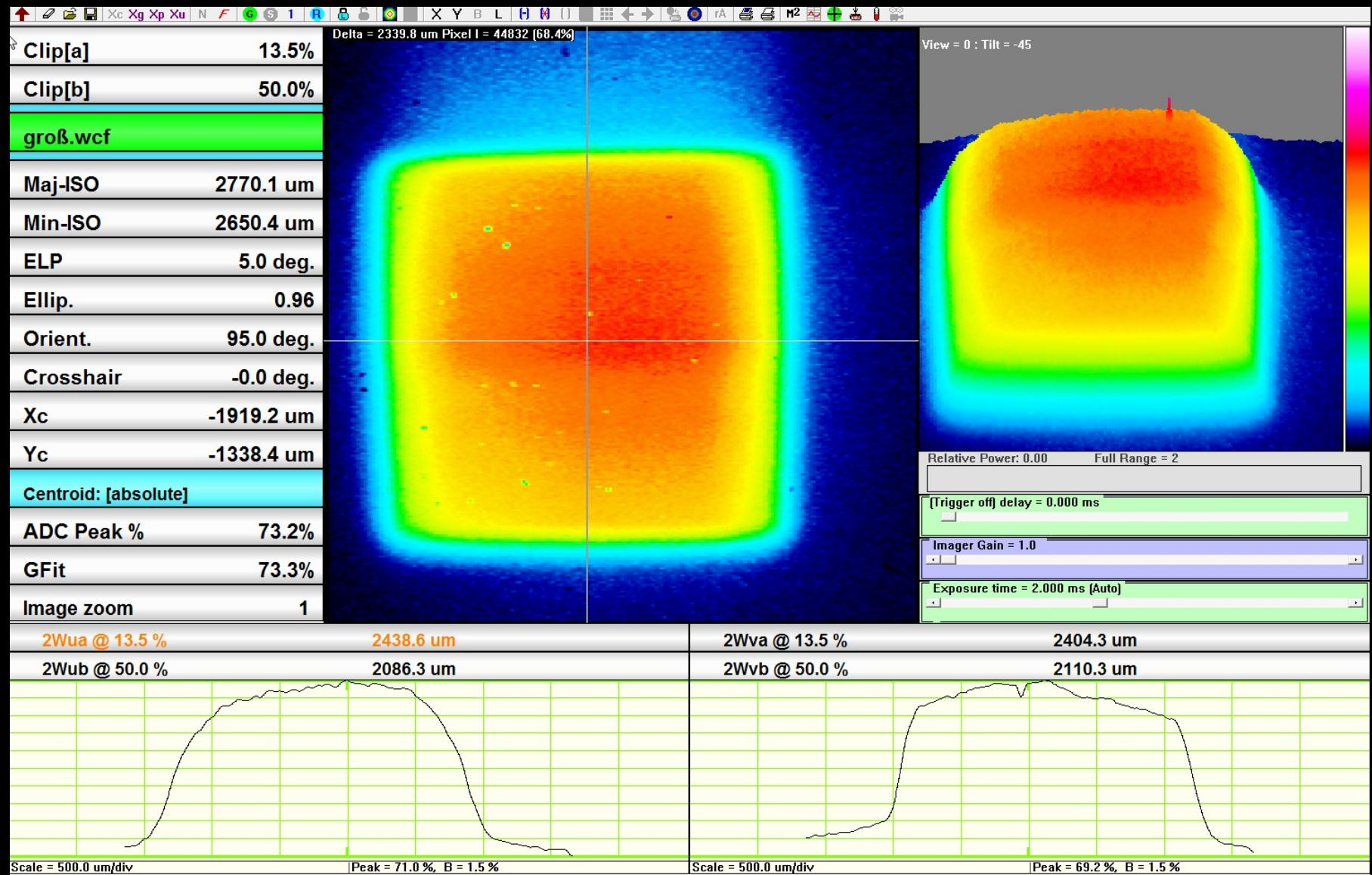
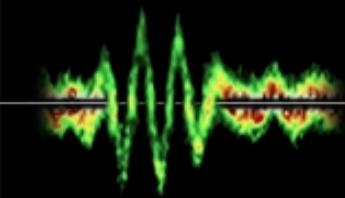
H3 imaging multi-pass - 13.5kW pump modules



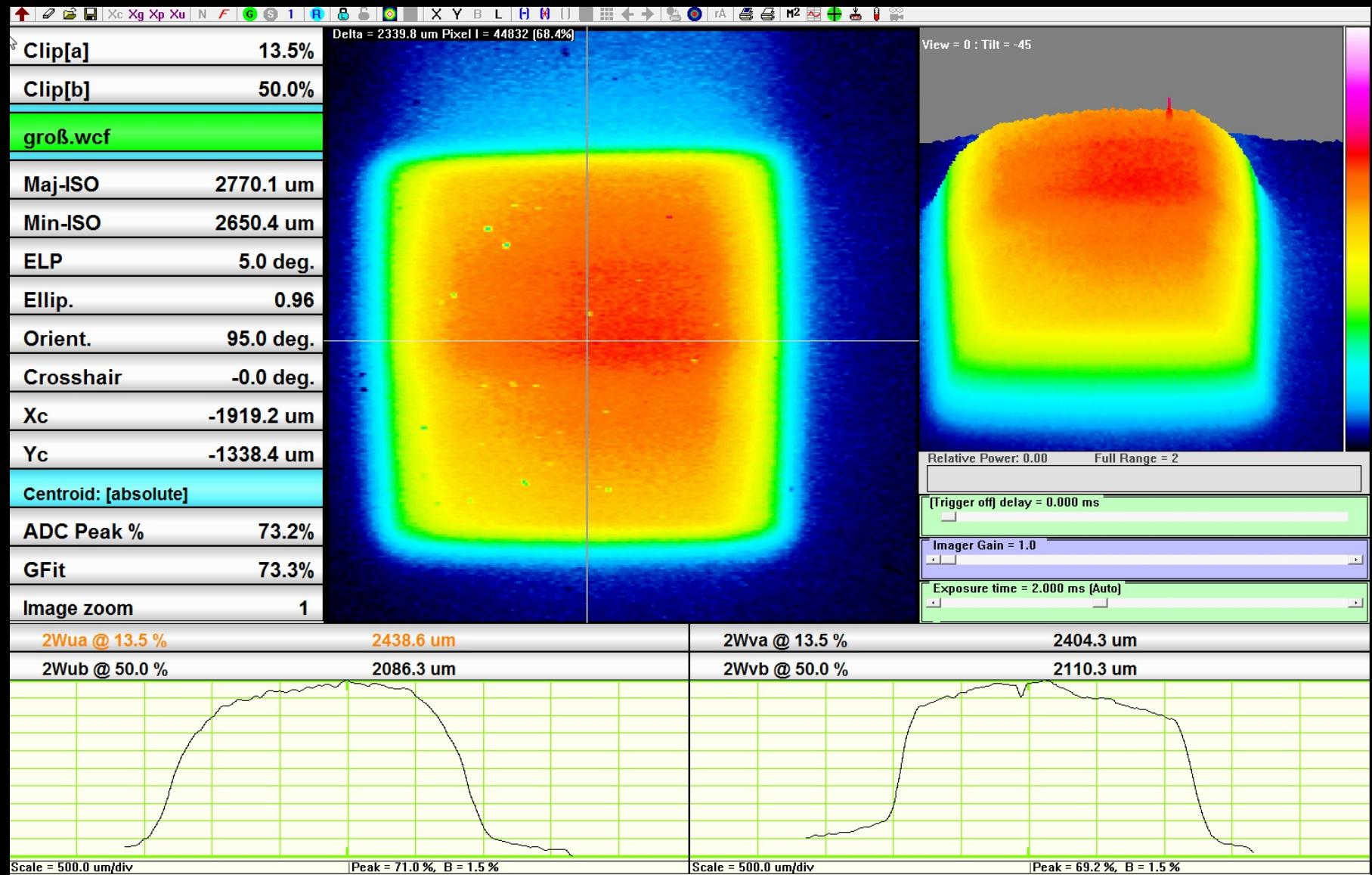
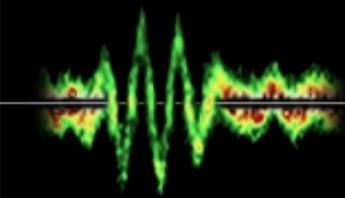
H3 imaging multi-pass - 13.5kW pump modules

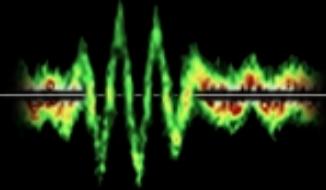


H3 imaging multi-pass - 13.5kW pump modules



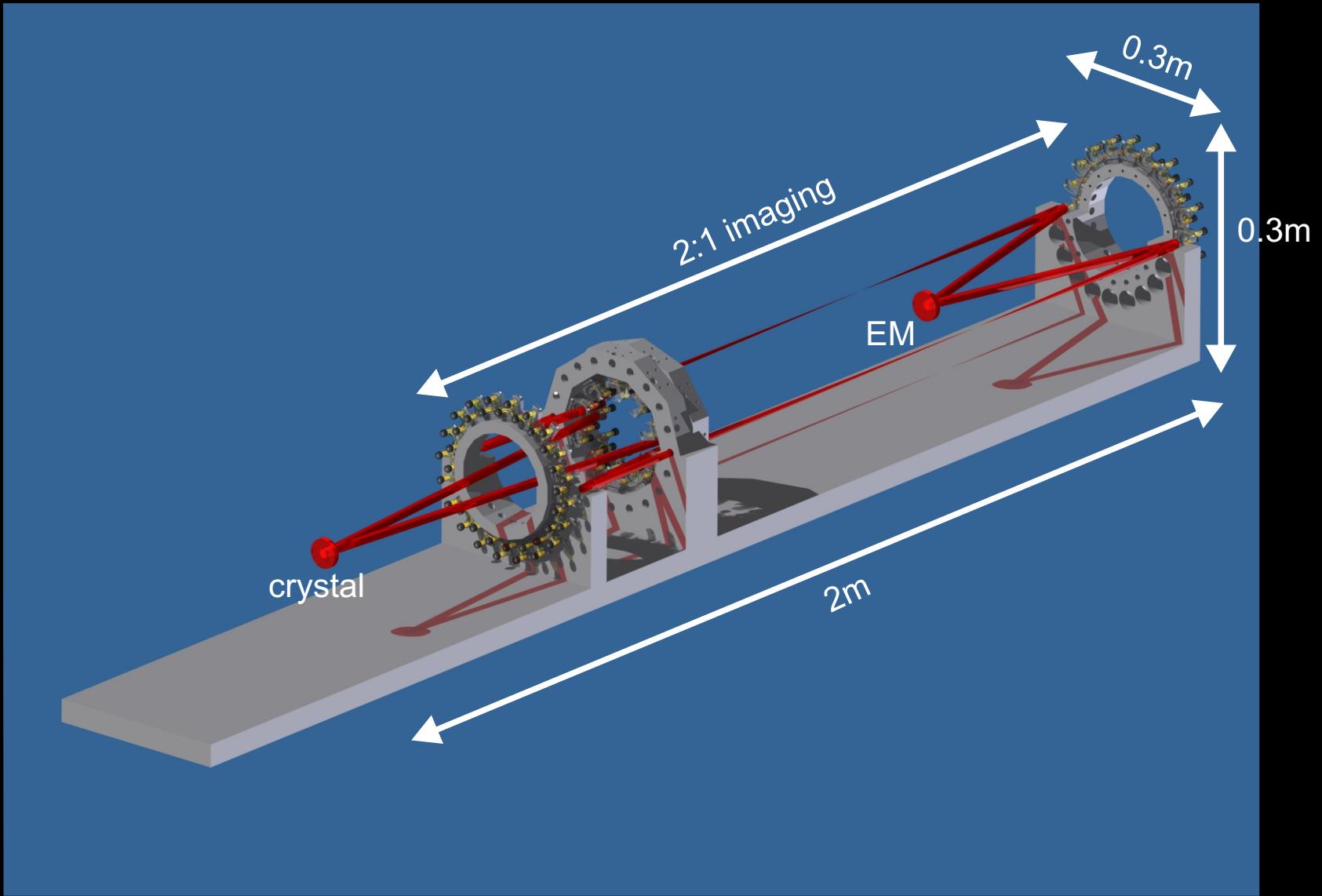
H3 imaging multi-pass - 10.6kW pump modules



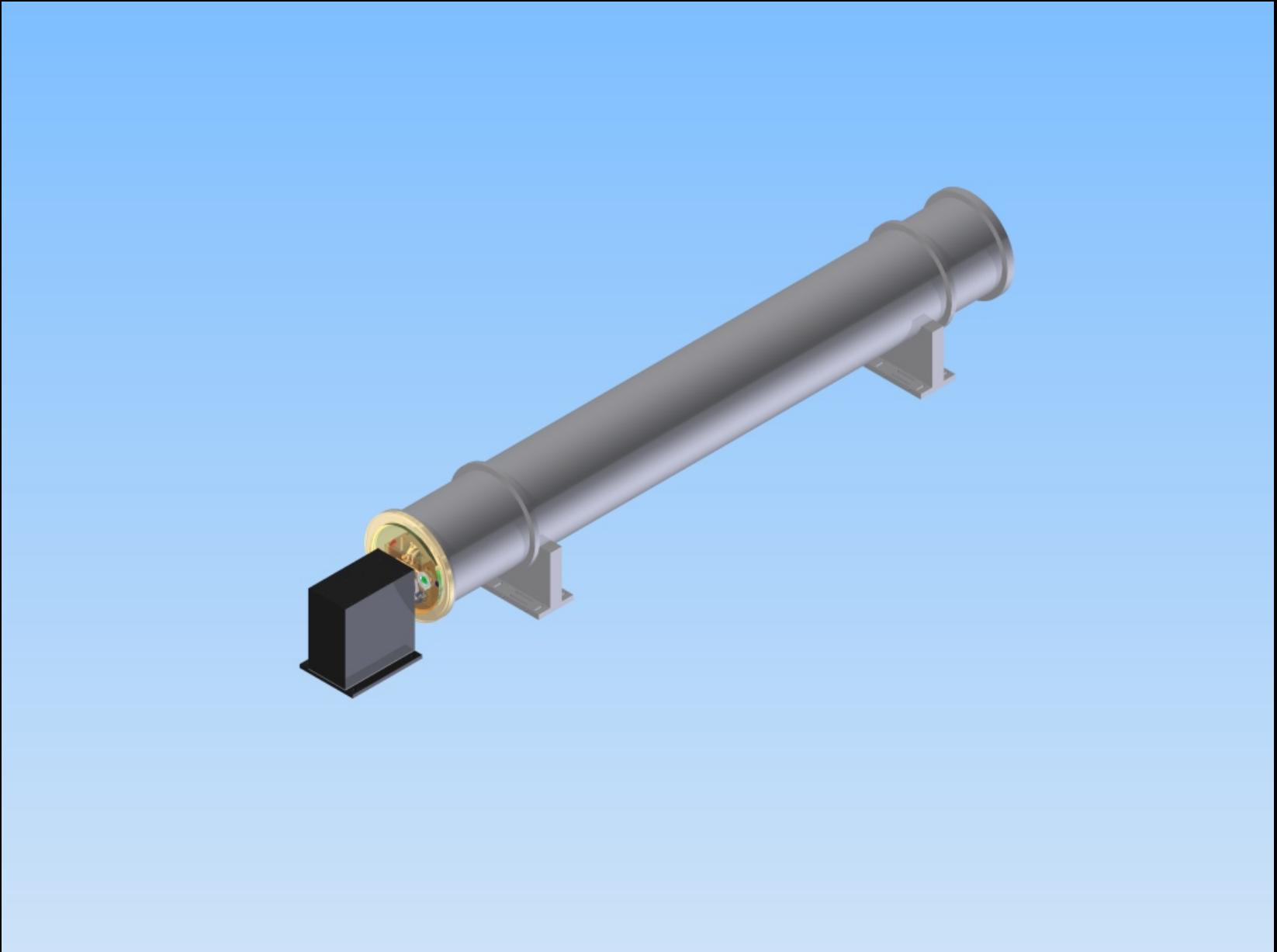


H3 imaging multi-pass - idea

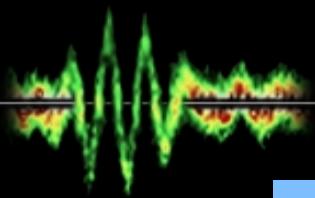
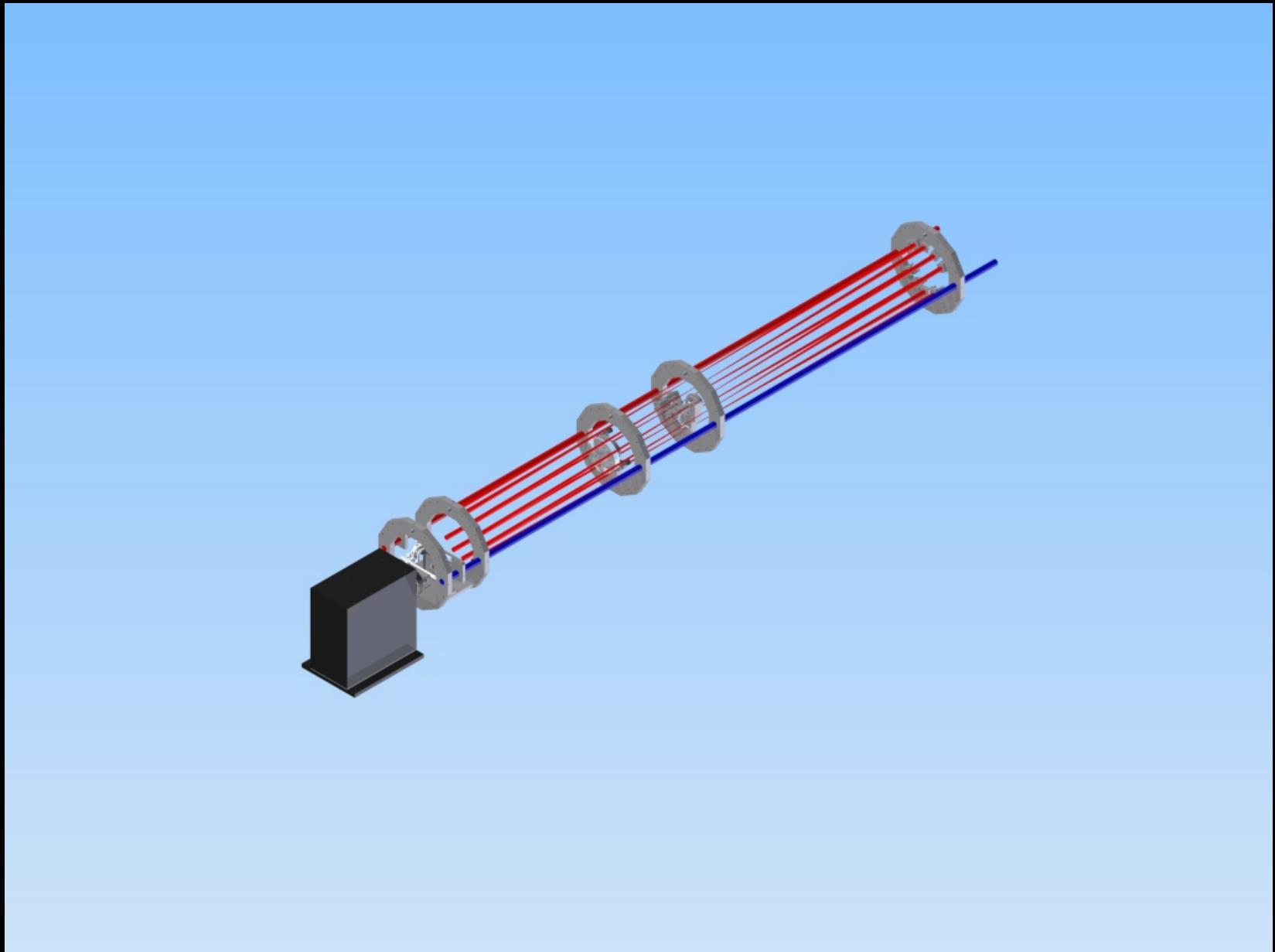
presented @ 6th HEC-DPSSL Workshop



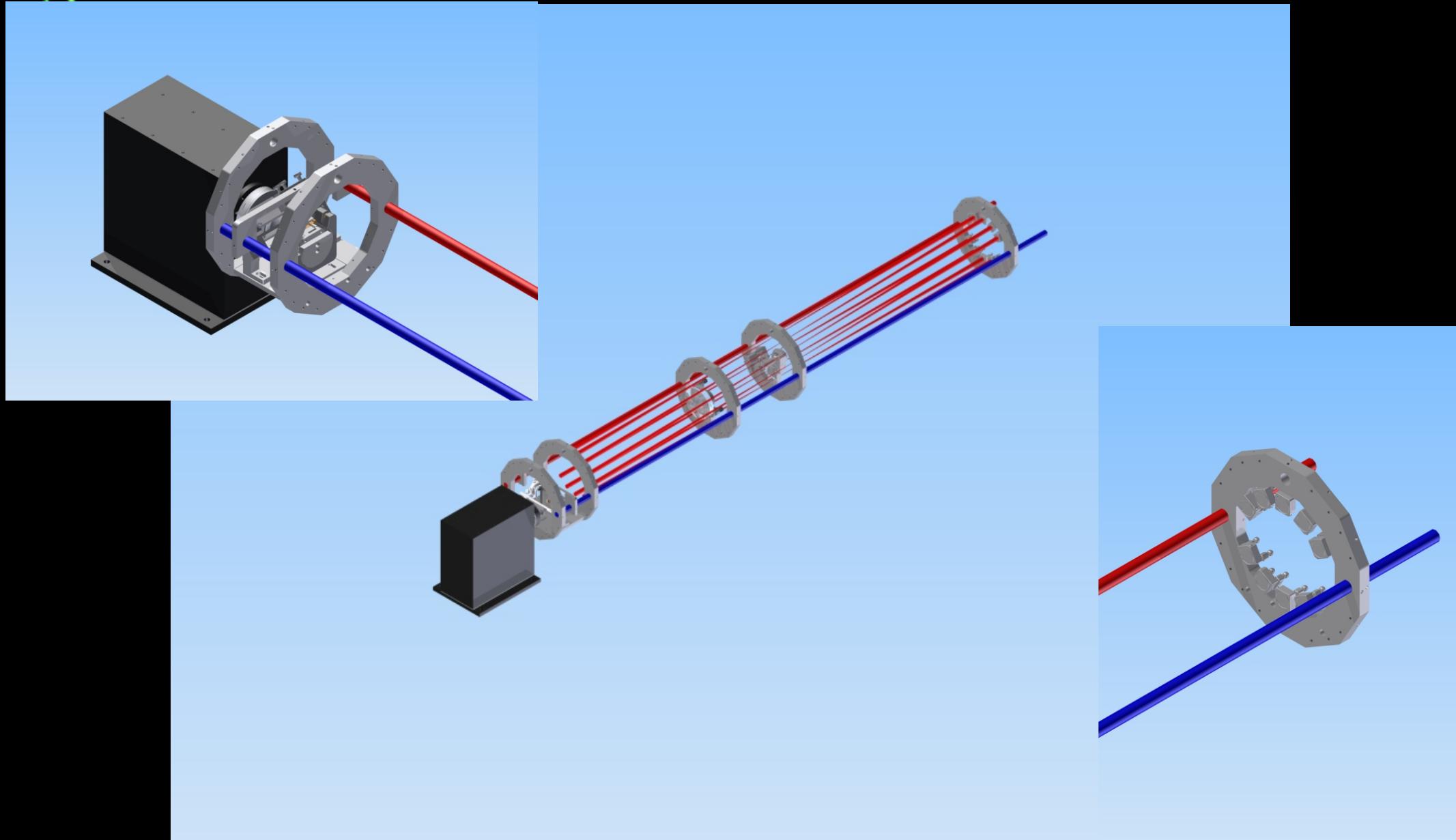
H3 imaging multi-pass - technical drawing



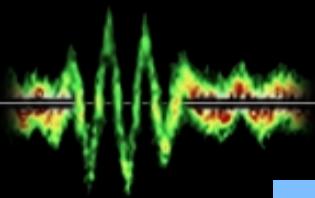
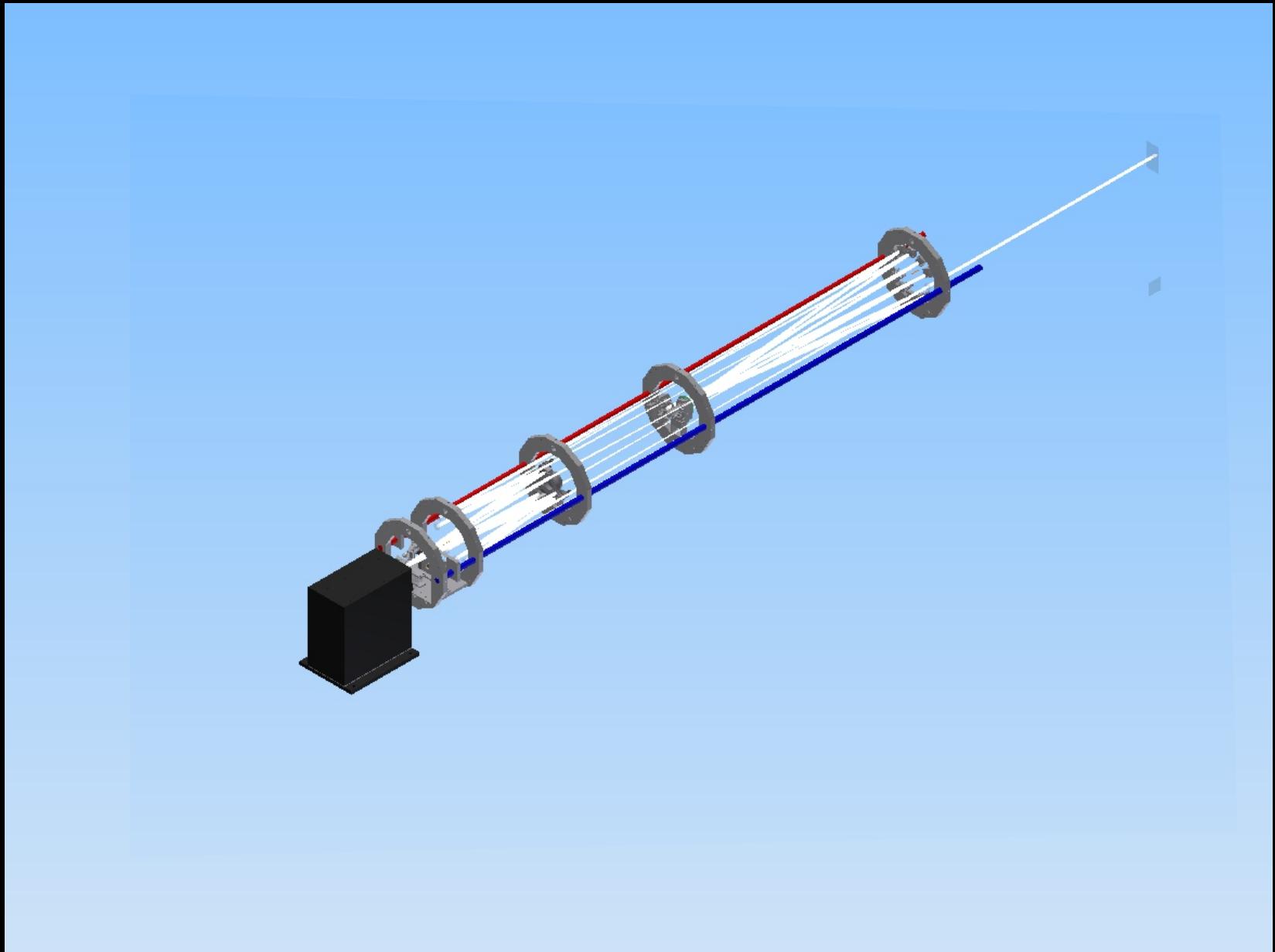
H3 imaging multi-pass - technical drawing



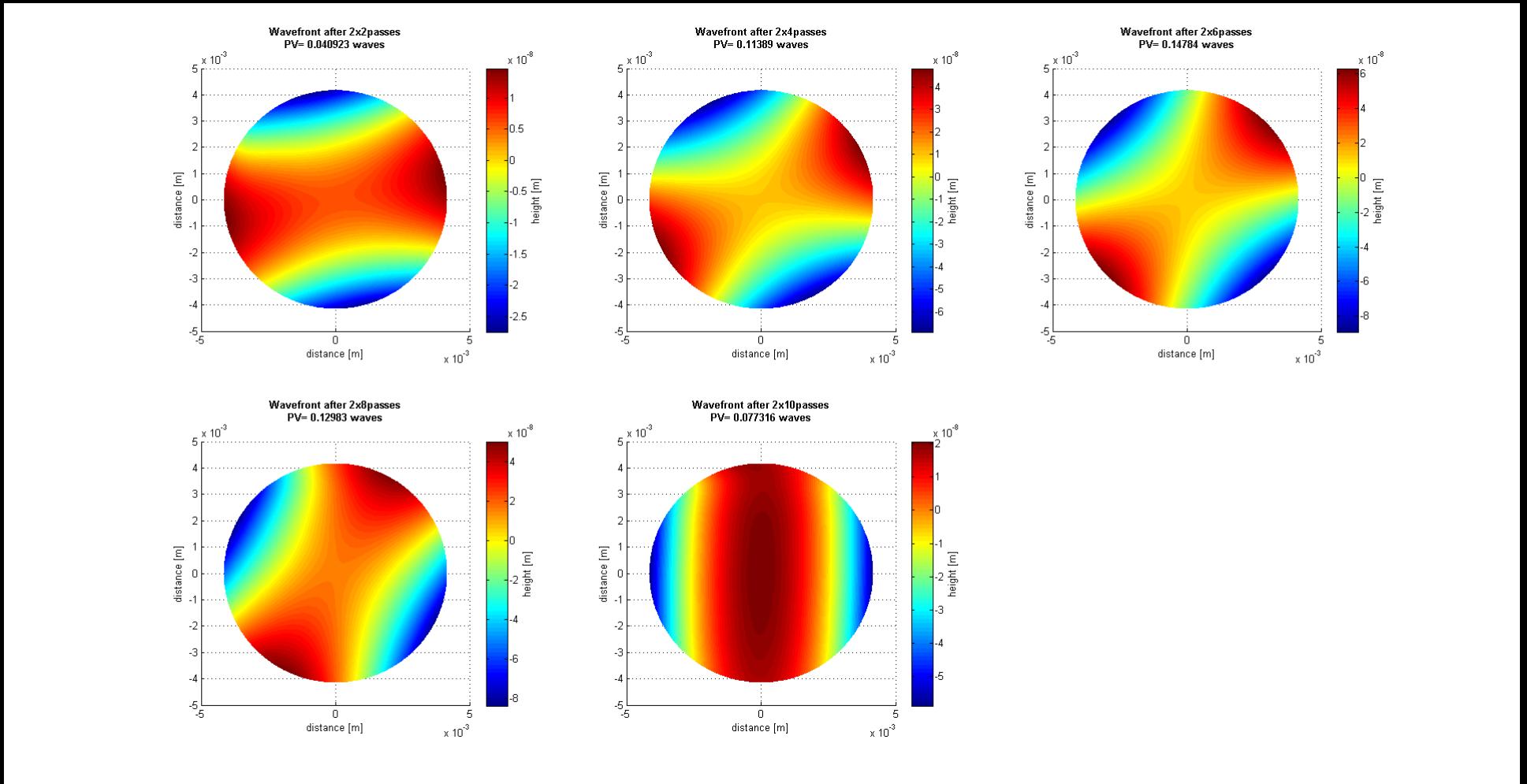
H3 imaging multi-pass - technical drawing



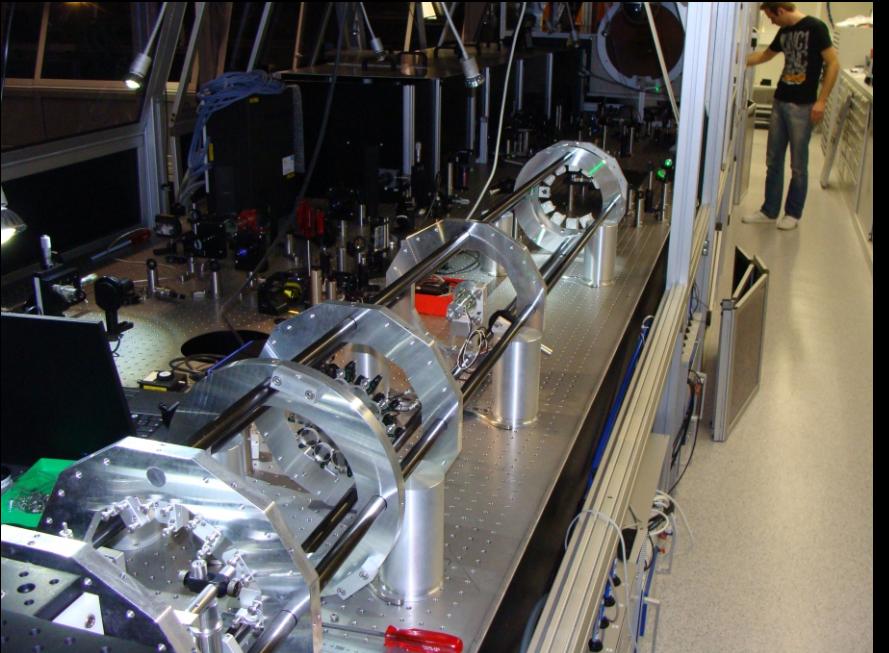
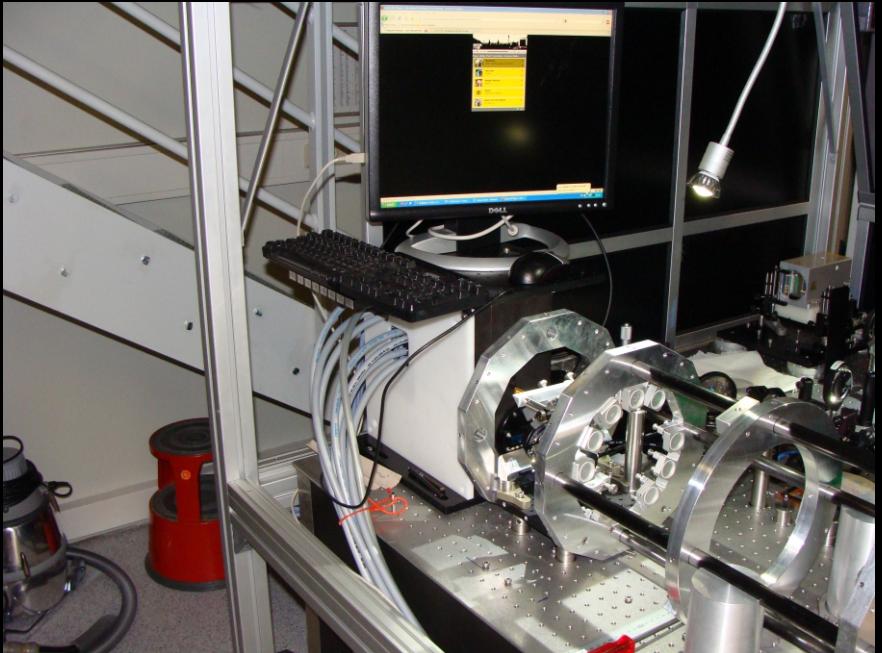
H3 imaging multi-pass - ray tracing



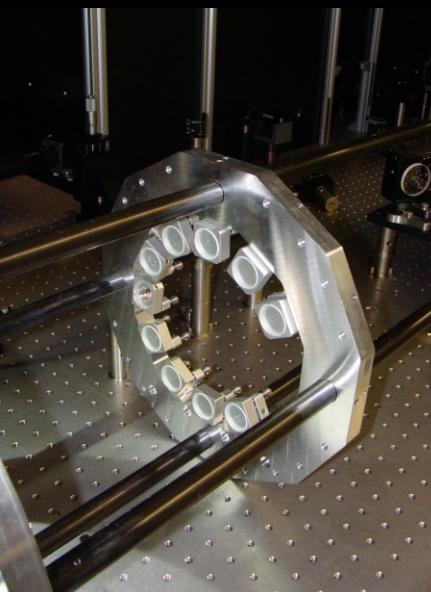
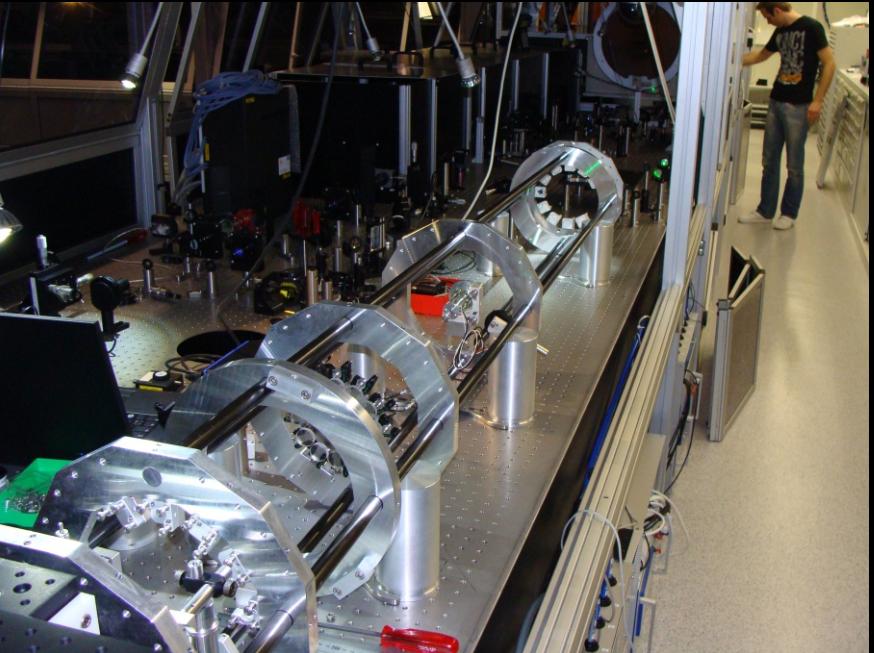
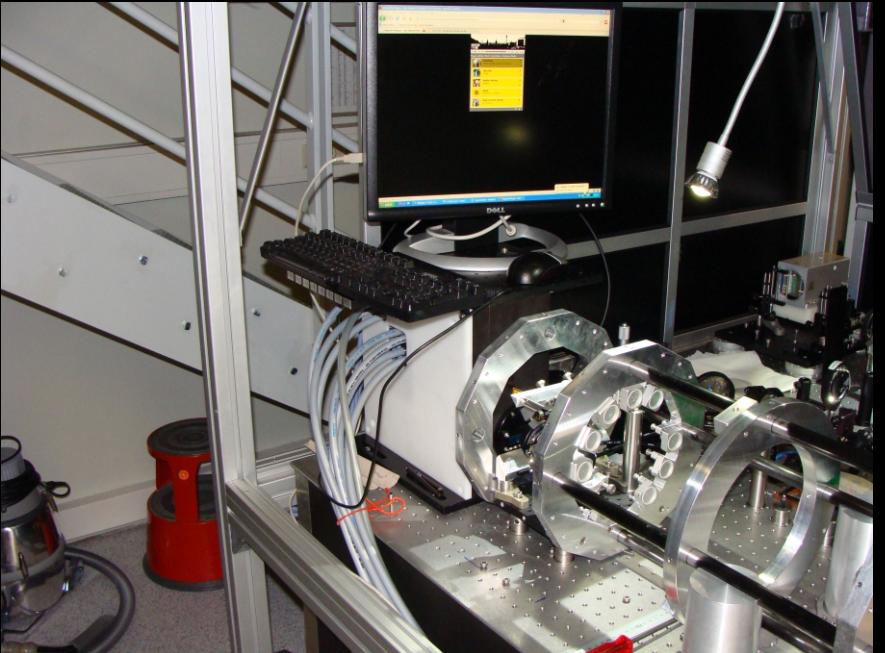
H3 imaging multi-pass - ray tracing



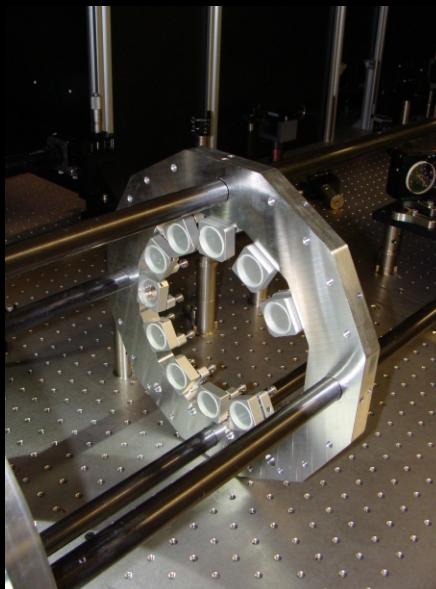
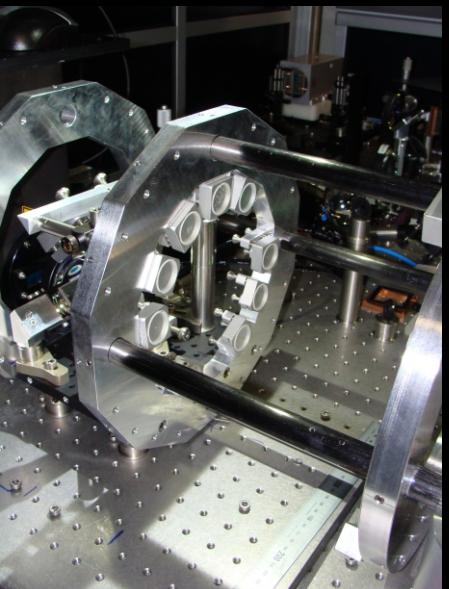
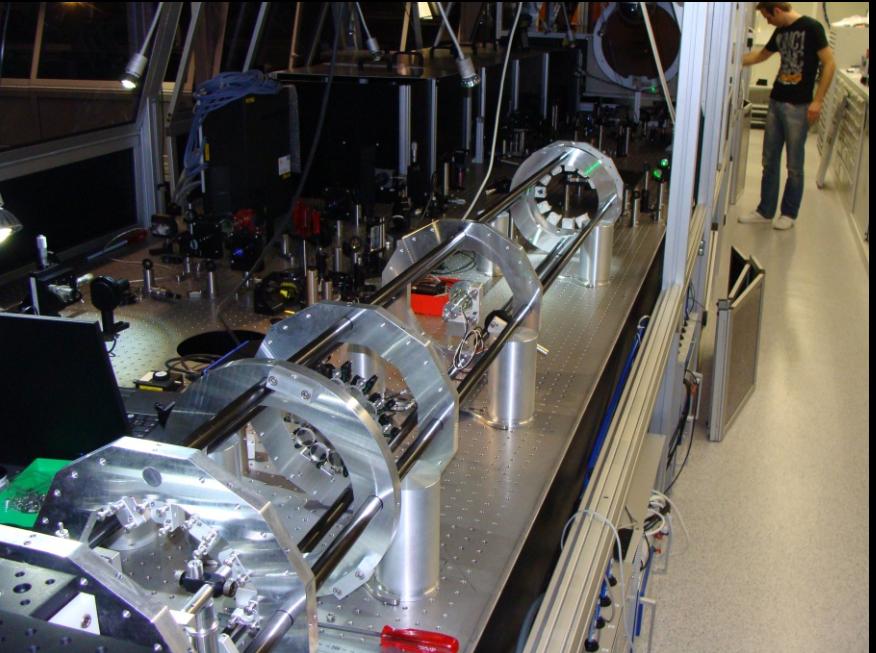
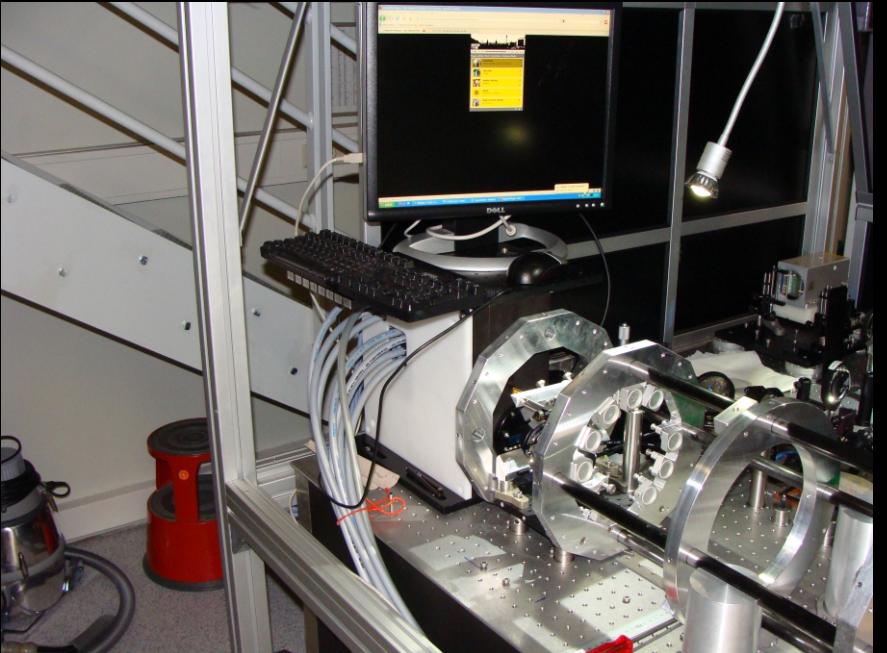
H3 imaging multi-pass - snapshots



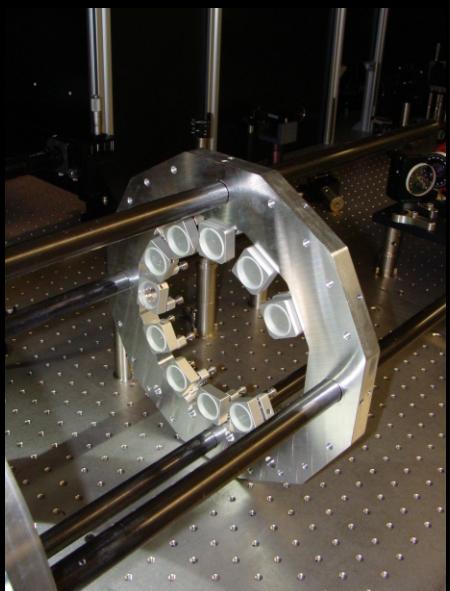
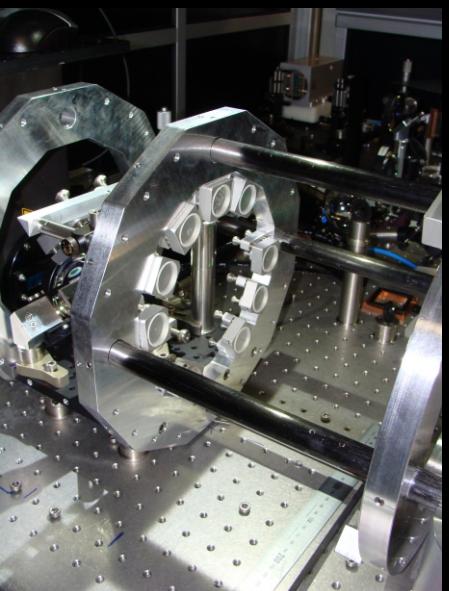
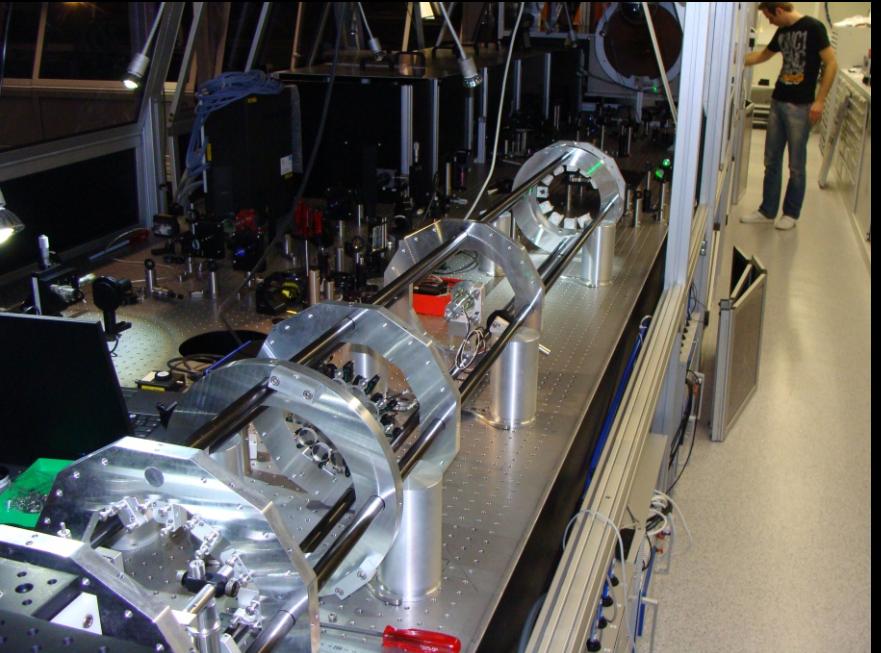
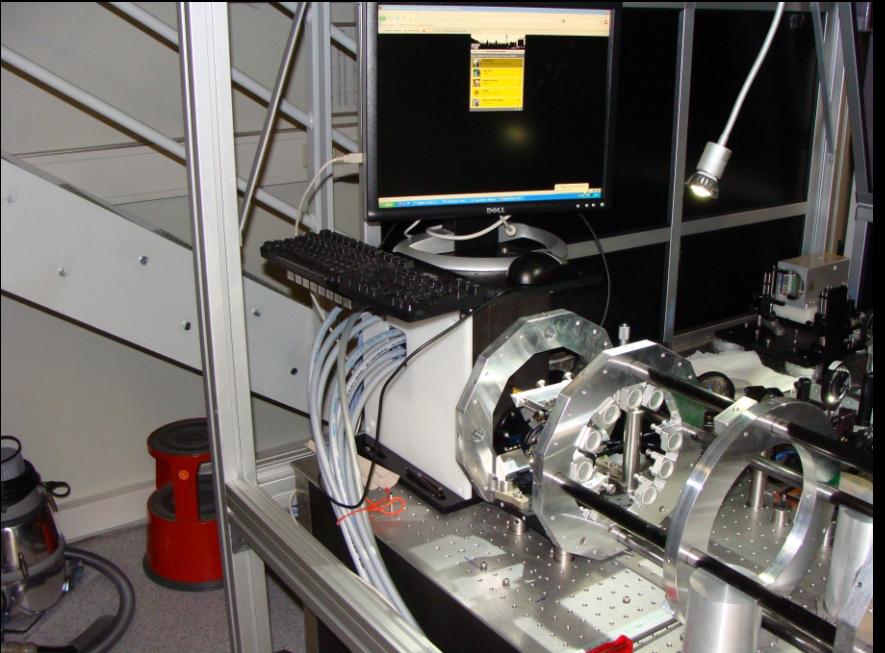
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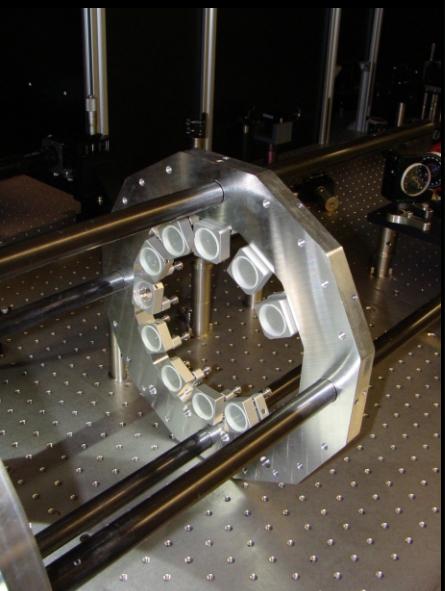
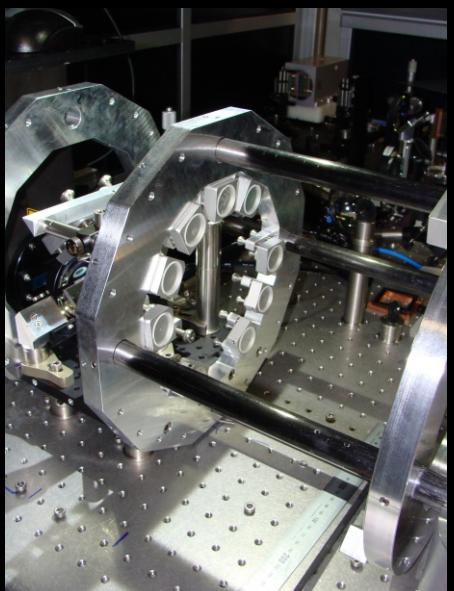
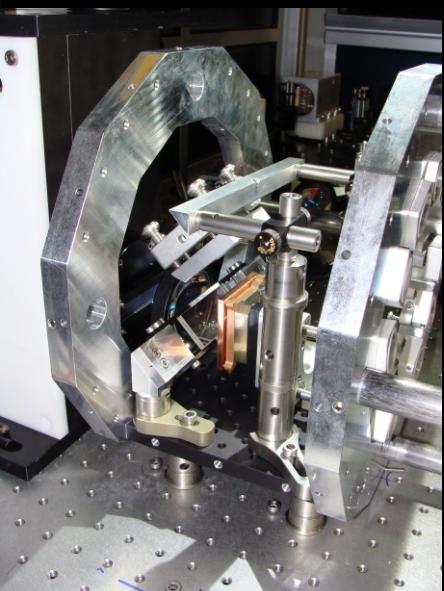
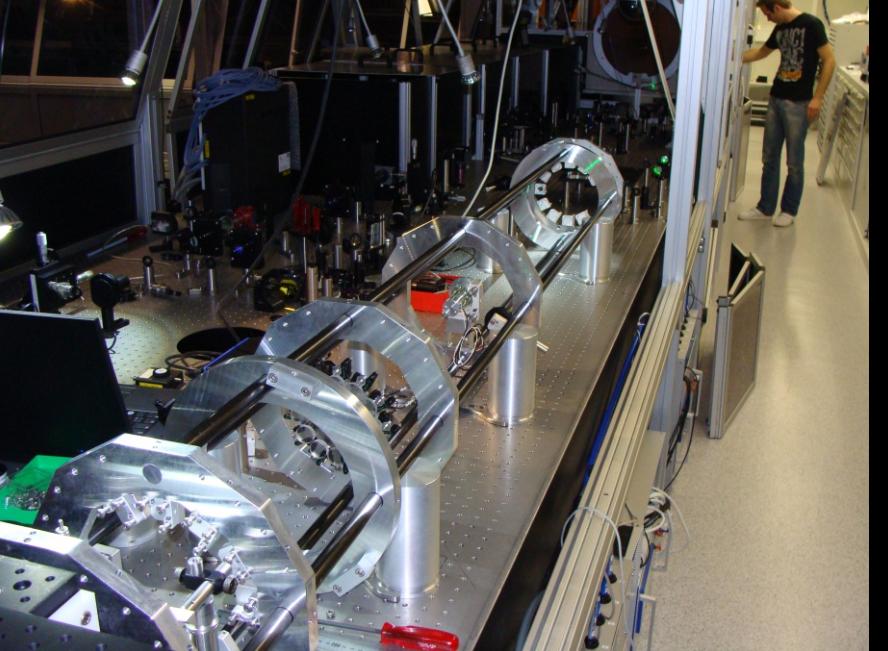
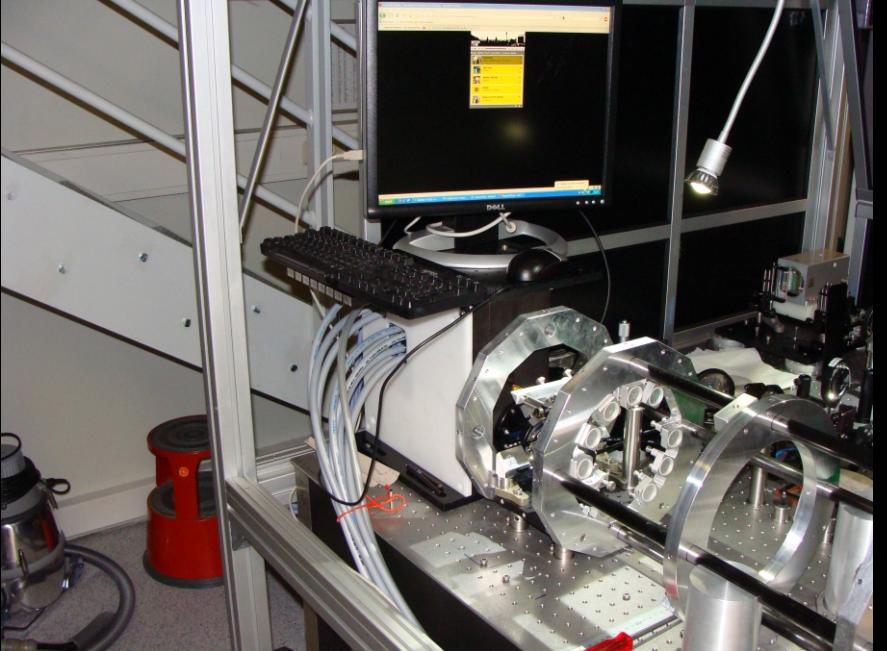
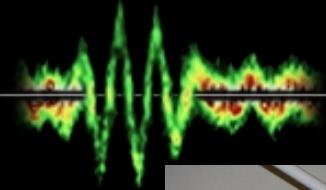
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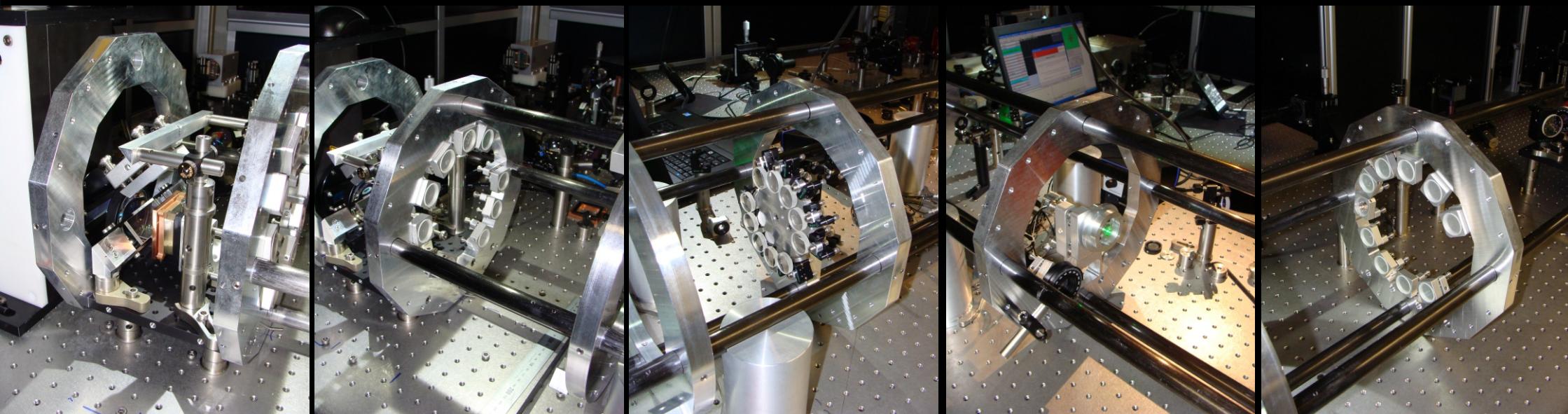
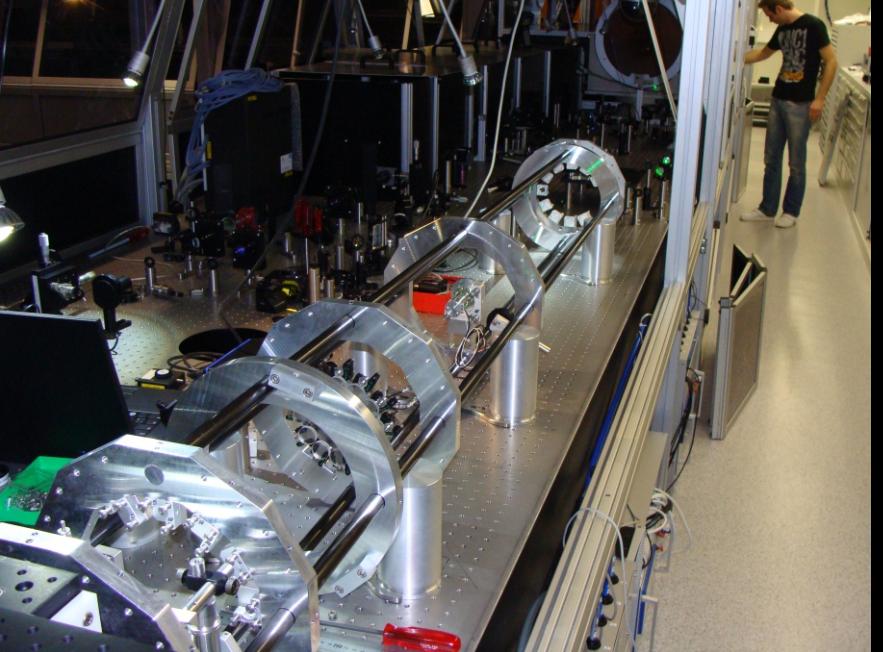
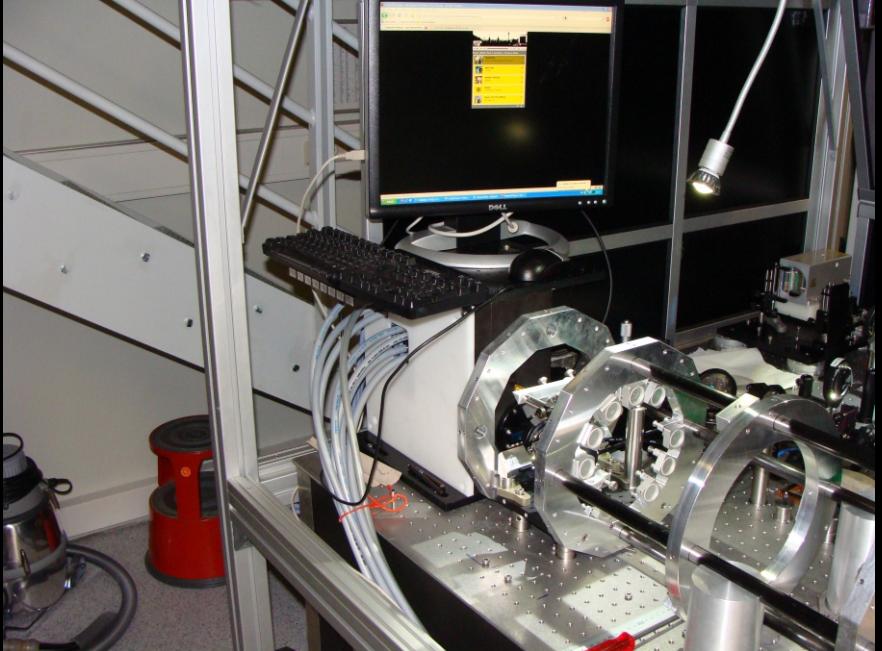
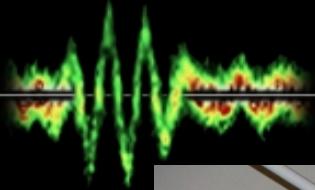
H3 imaging multi-pass - snapshots



H3 imaging multi-pass - snapshots



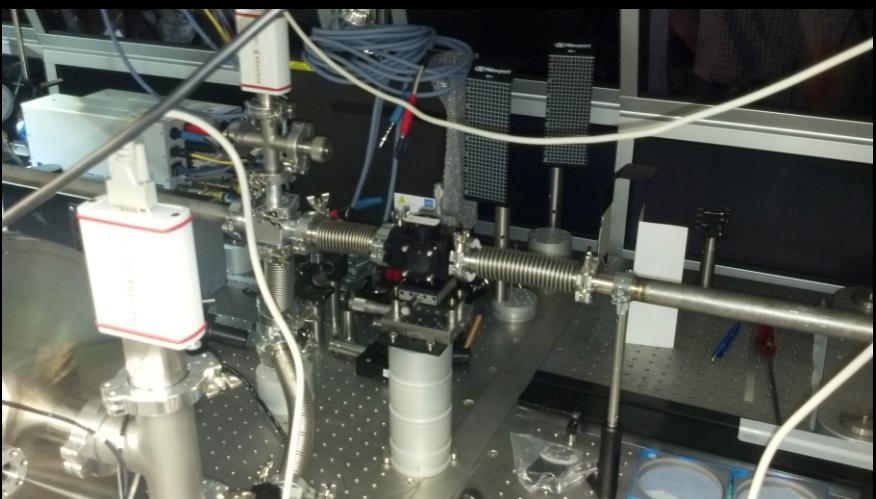
H3 imaging multi-pass - snapshots



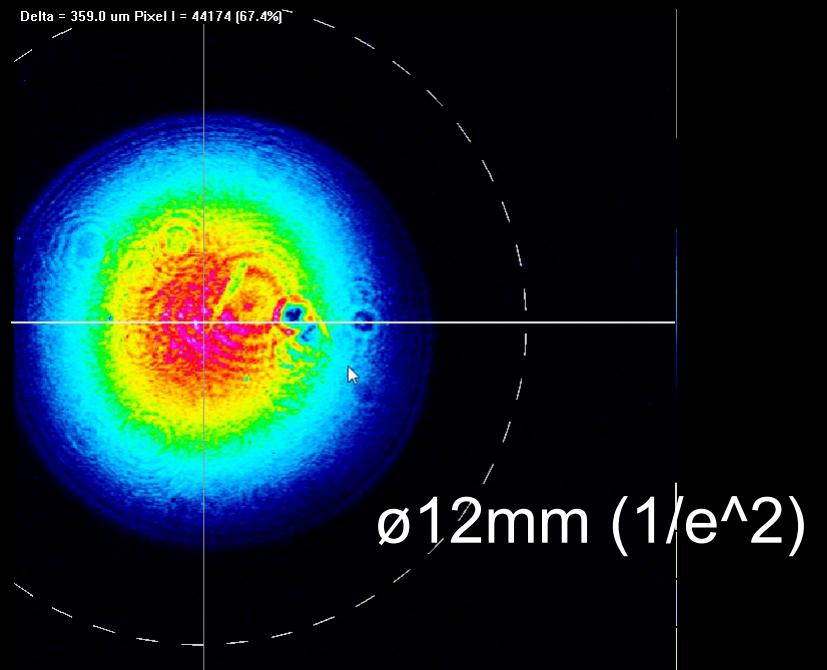
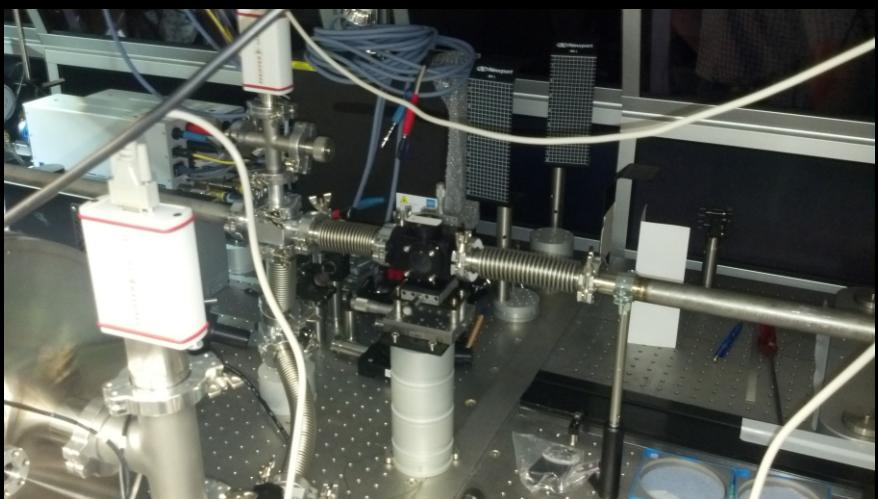
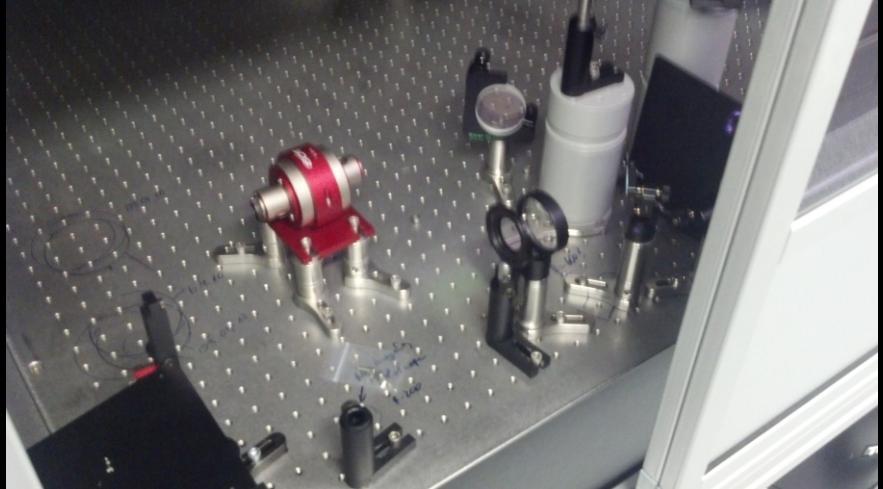
H3 imaging multi-pass - snapshots



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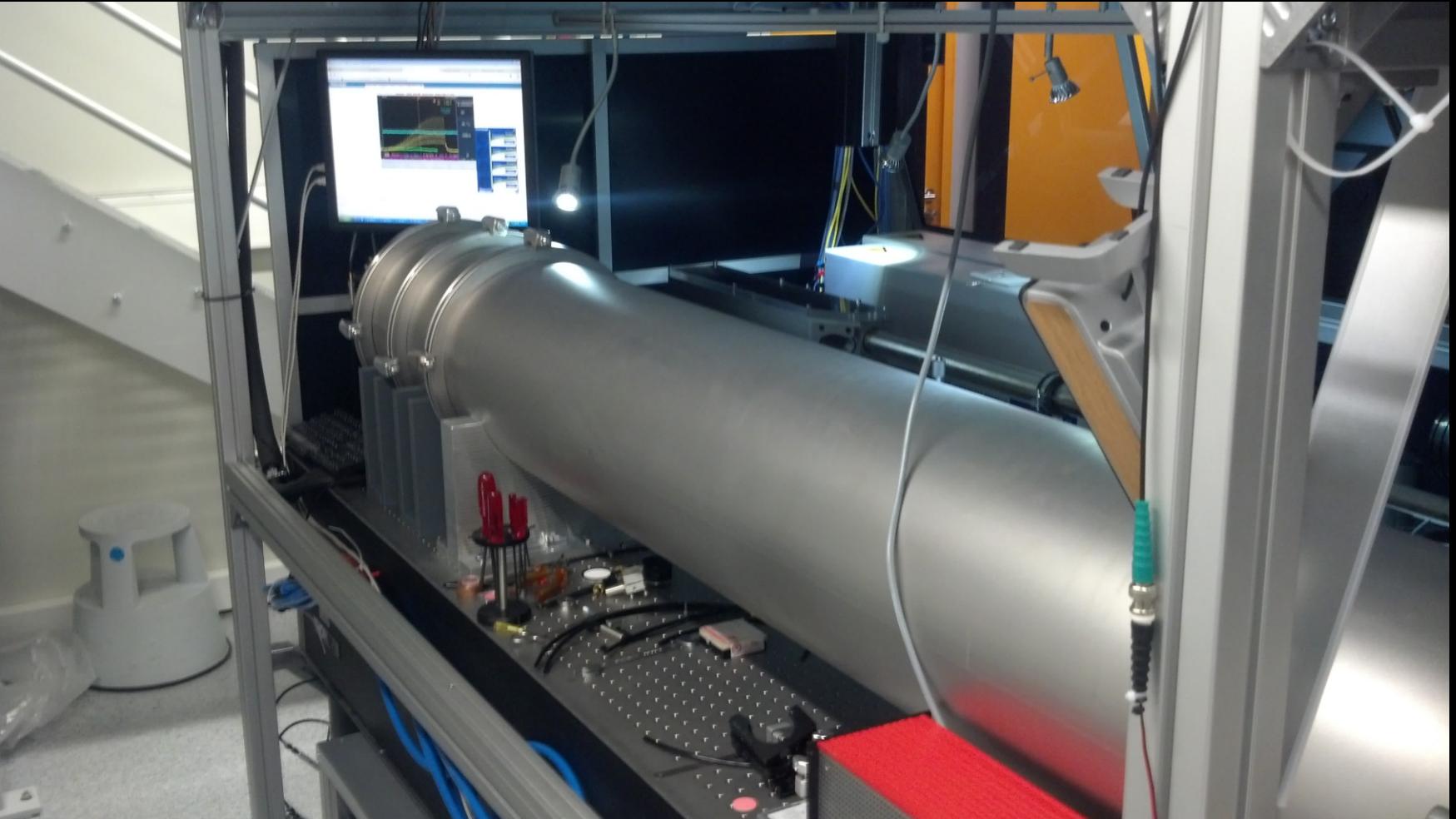


H3 imaging multi-pass - snapshots

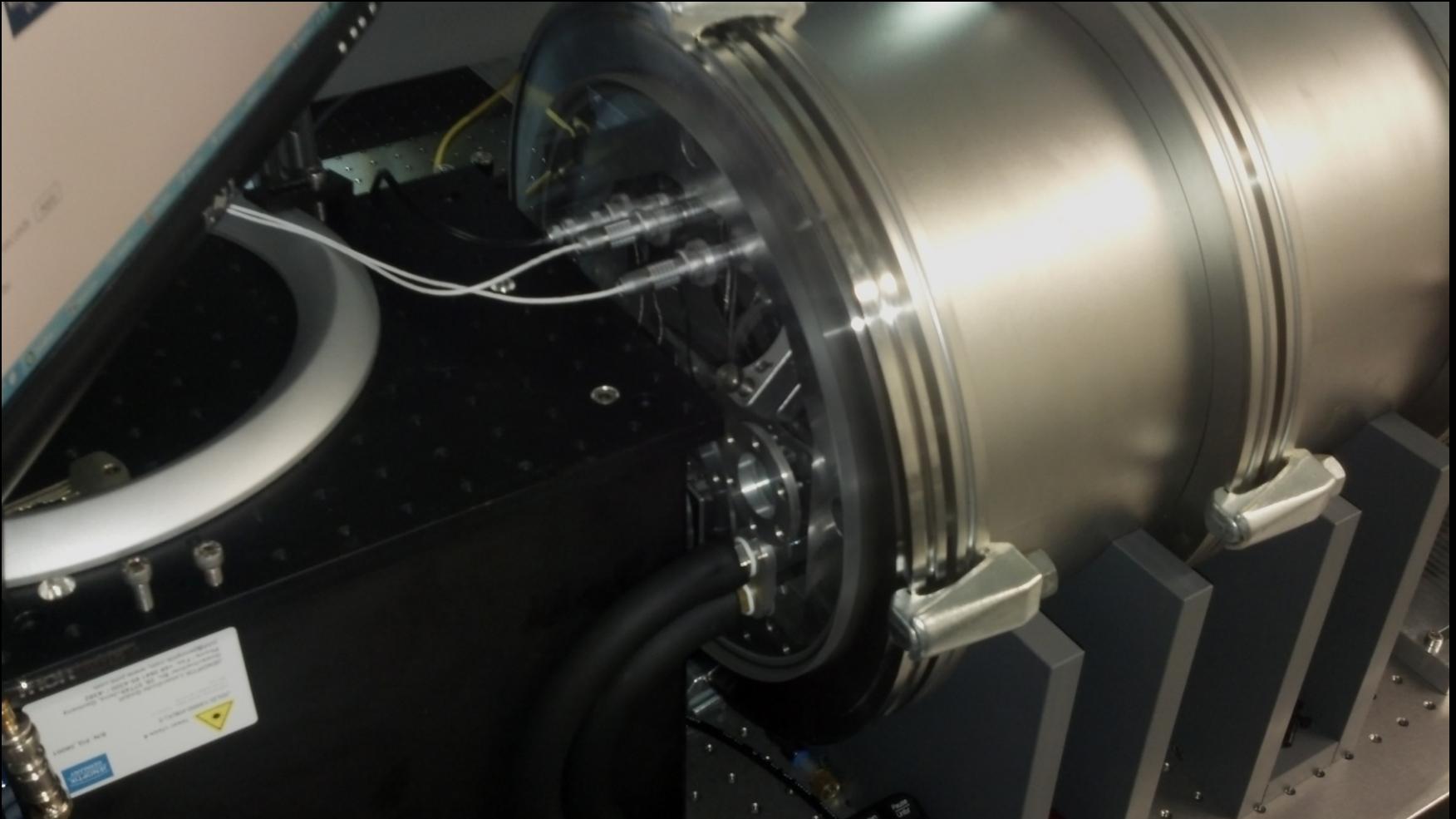


input plane

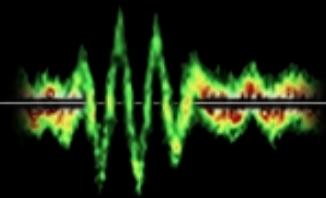
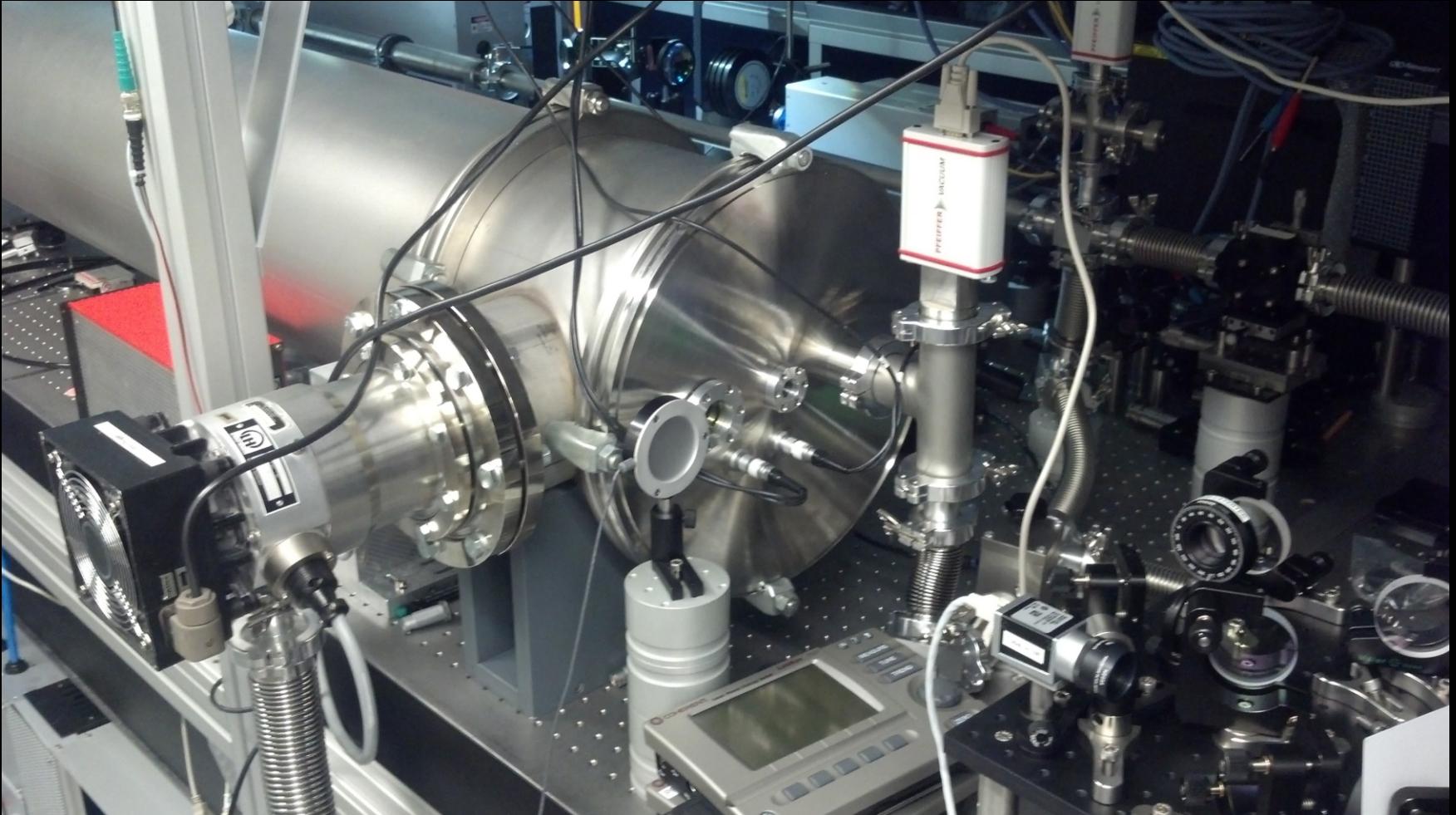
H3 imaging multi-pass - snapshots



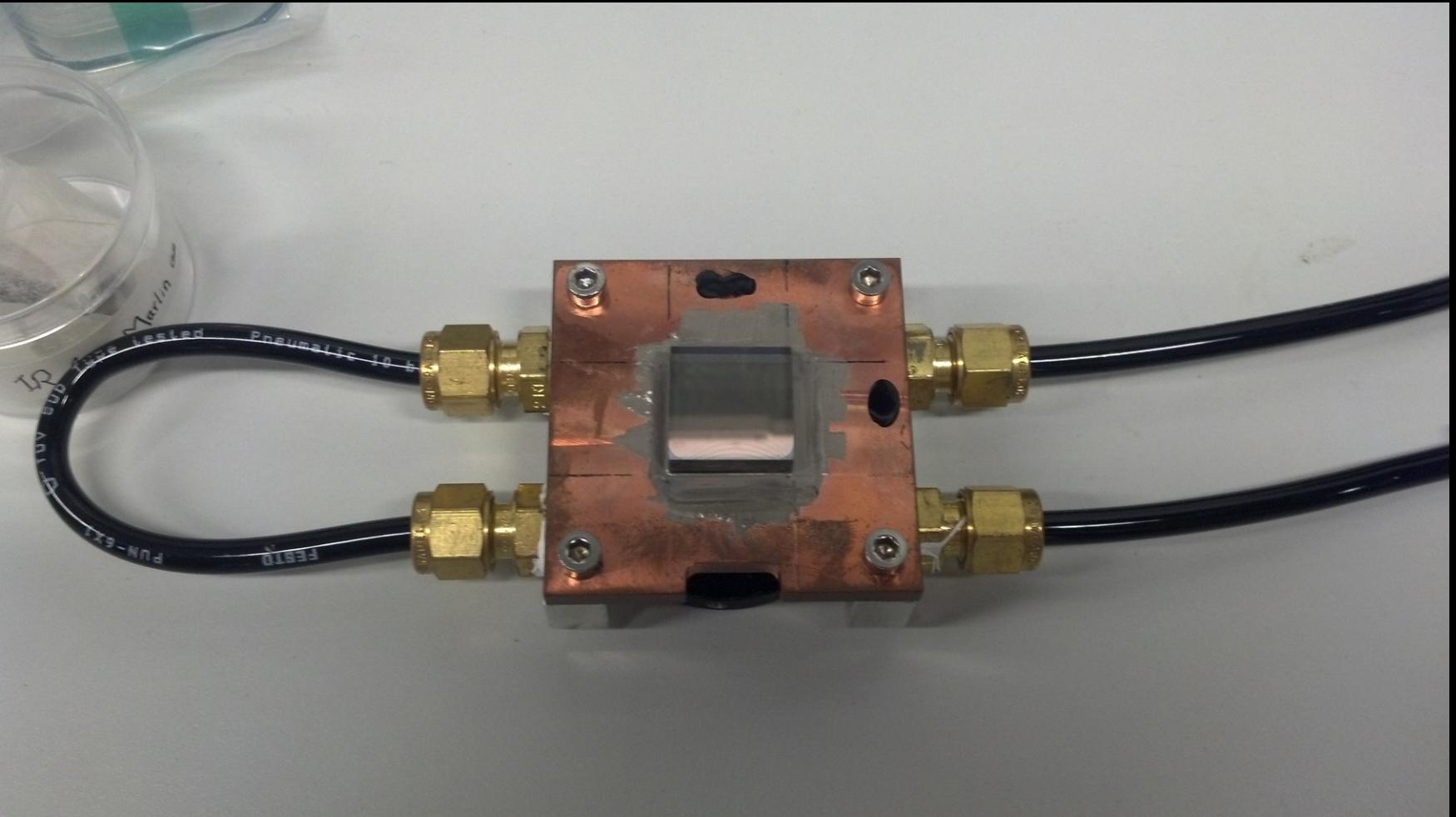
H3 imaging multi-pass - snapshots



H3 imaging multi-pass - snapshots



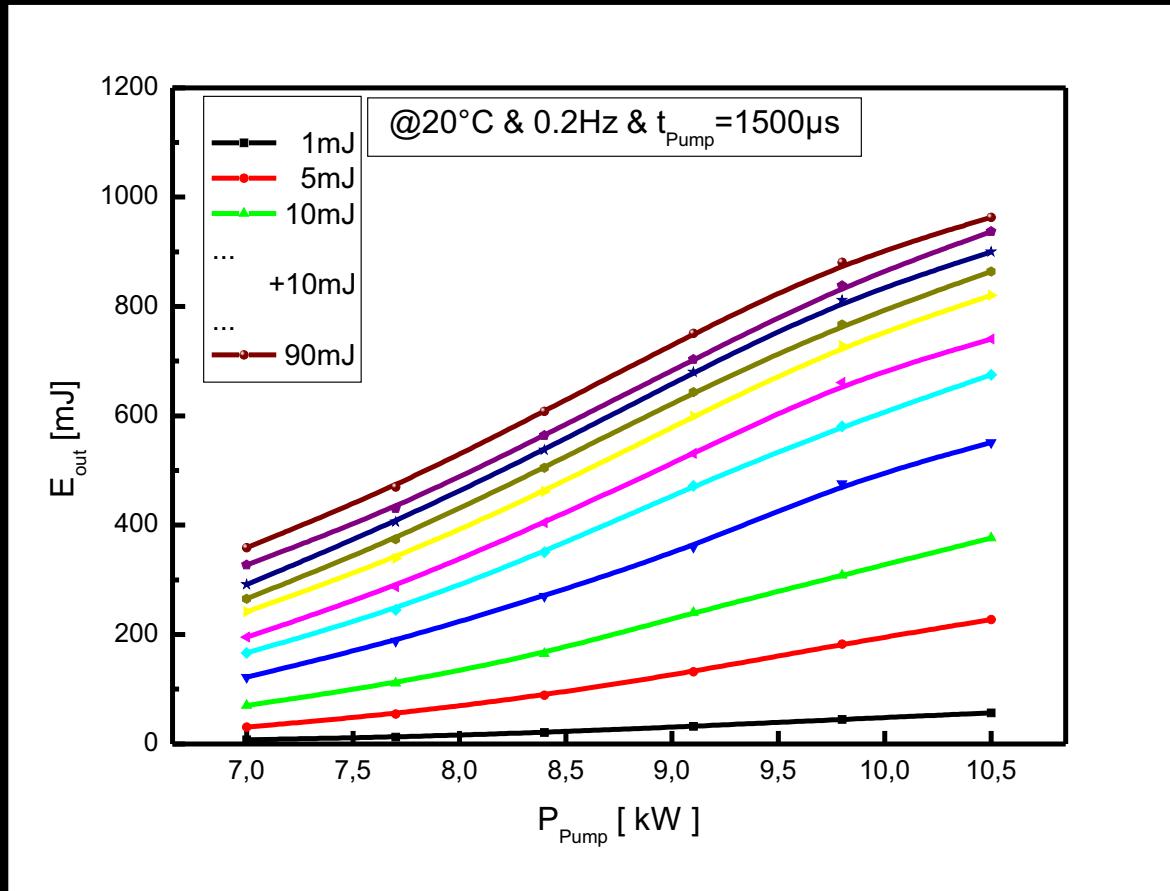
H3 imaging multi-pass - first vacuum tests



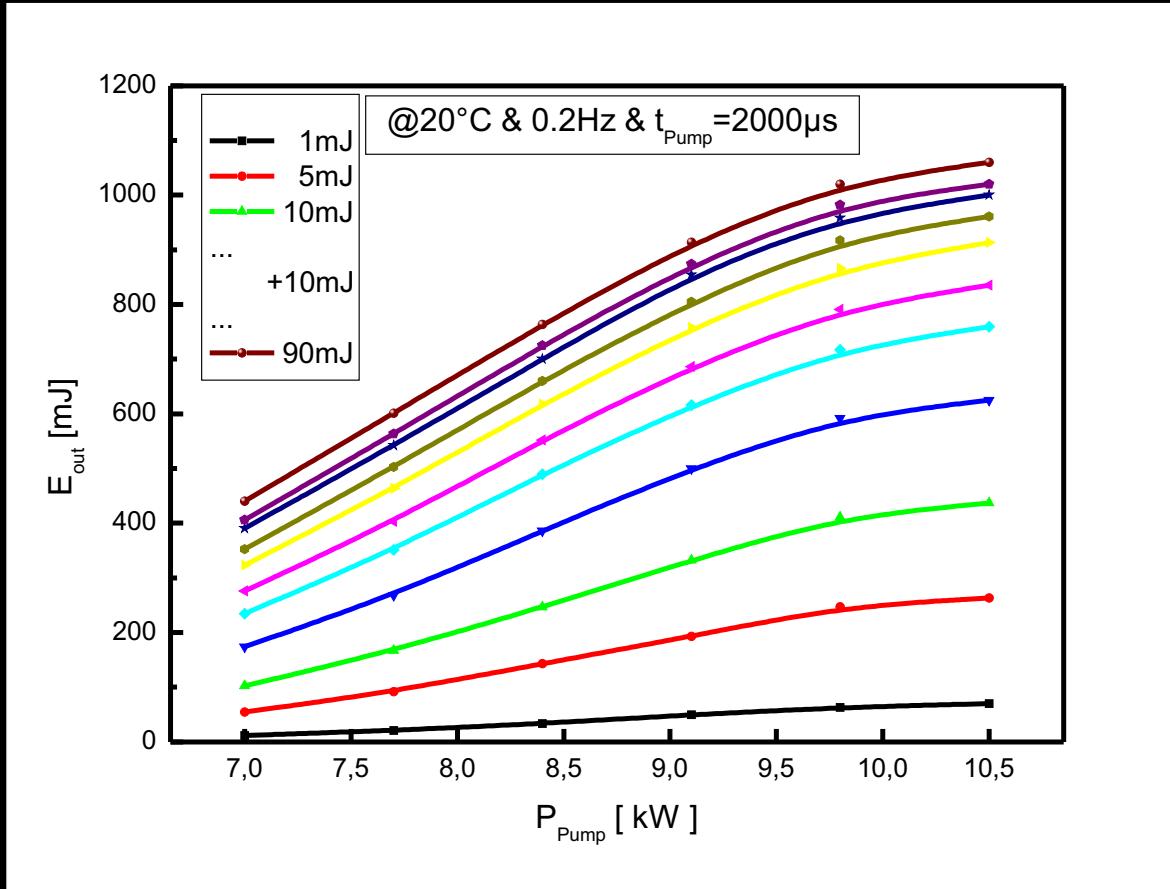
20x20x6mm x 2%dop. AM Yb:YAG crystal



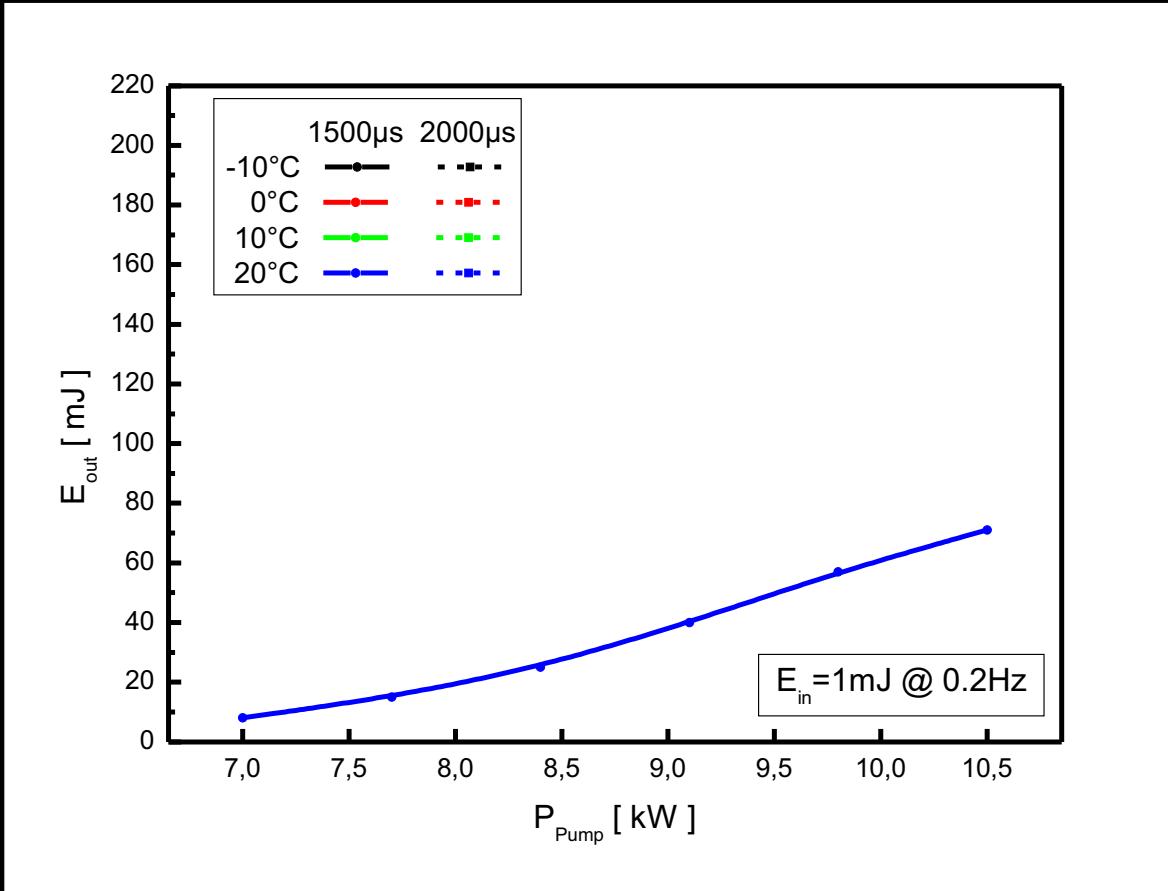
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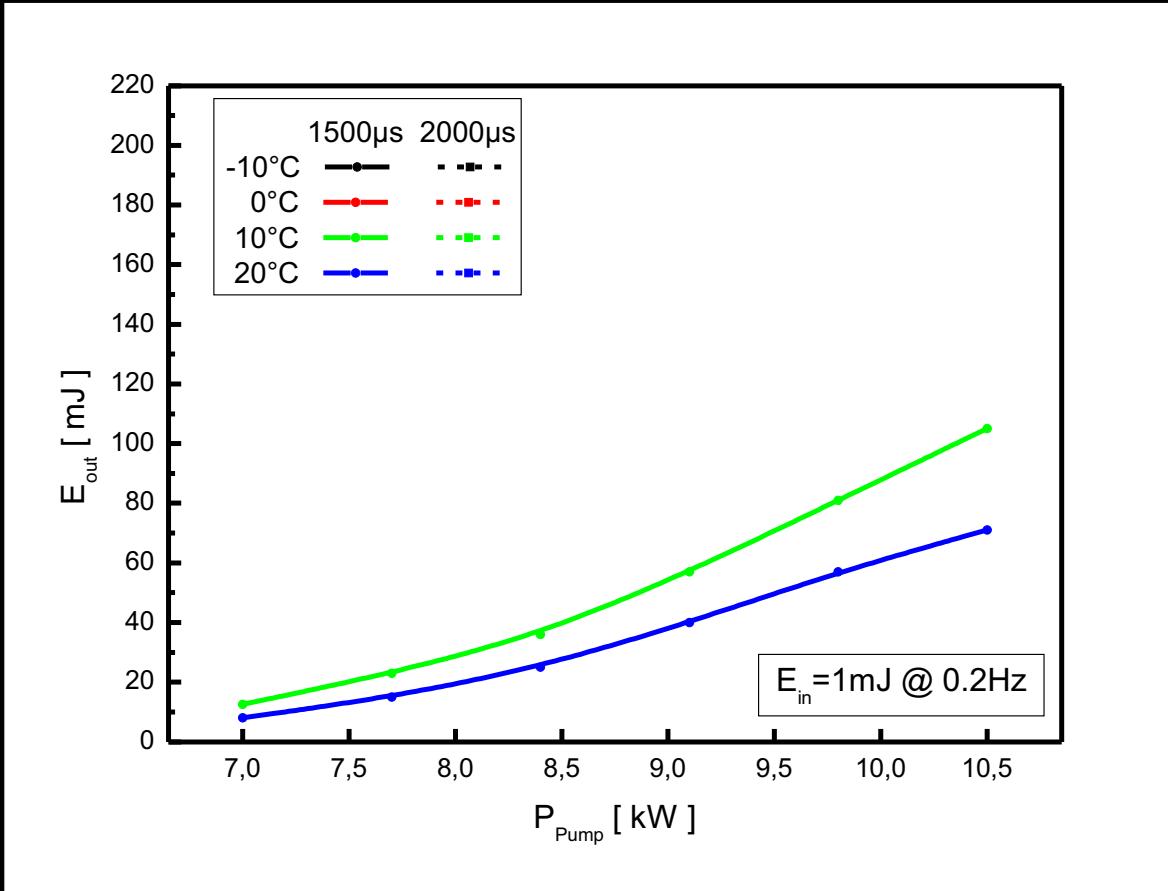
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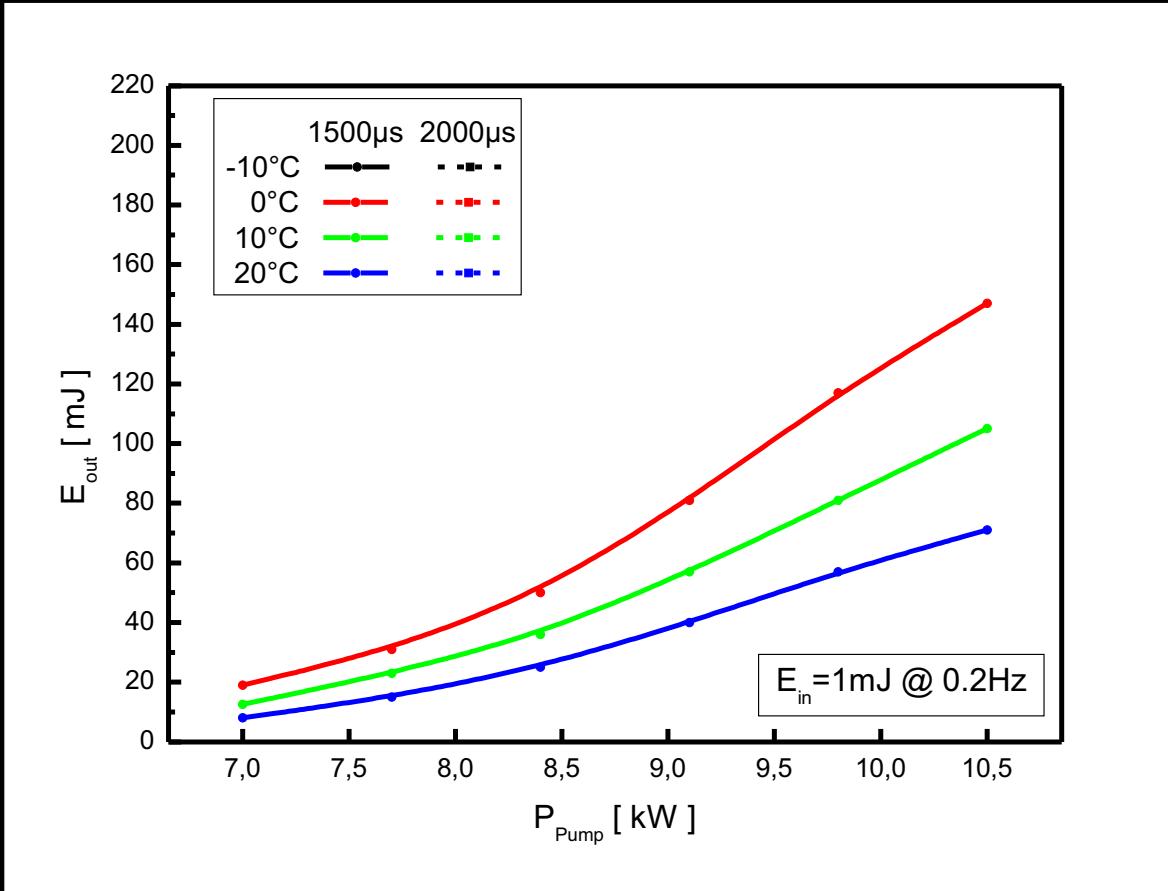
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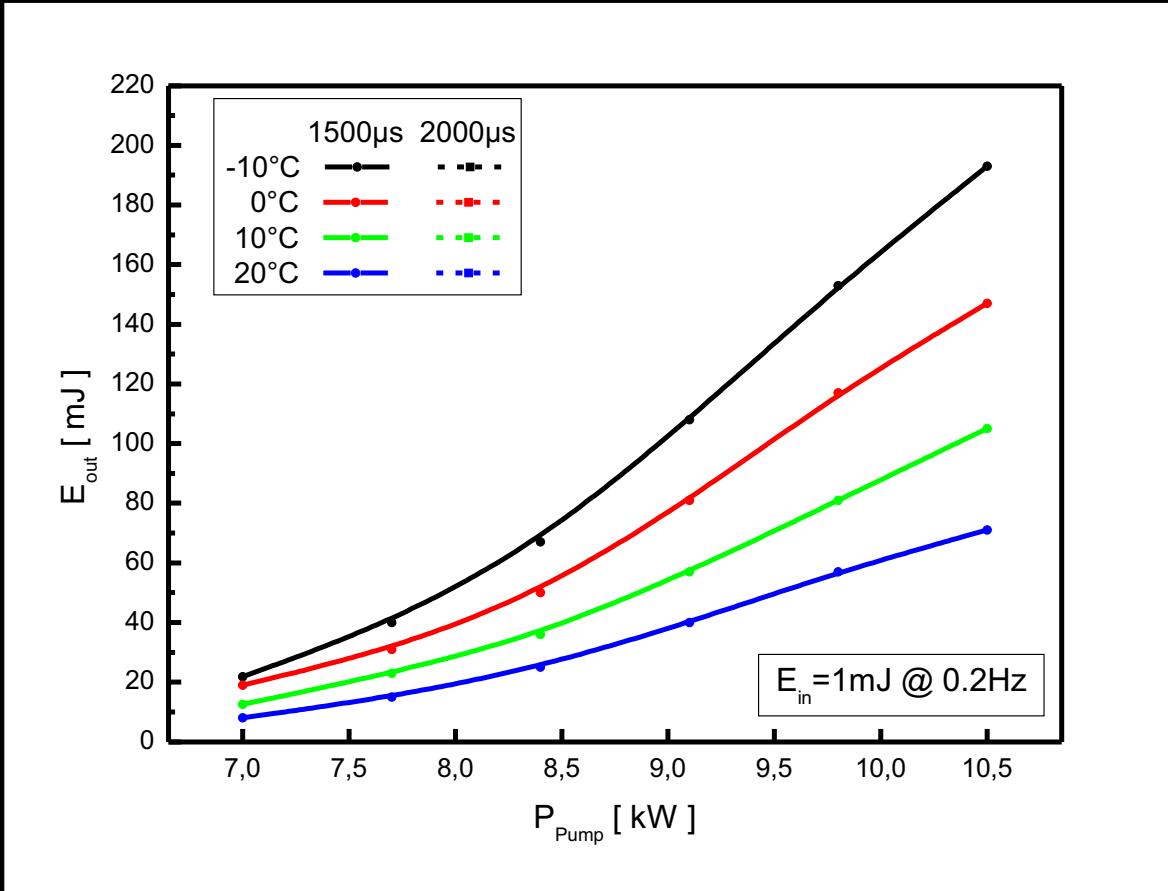
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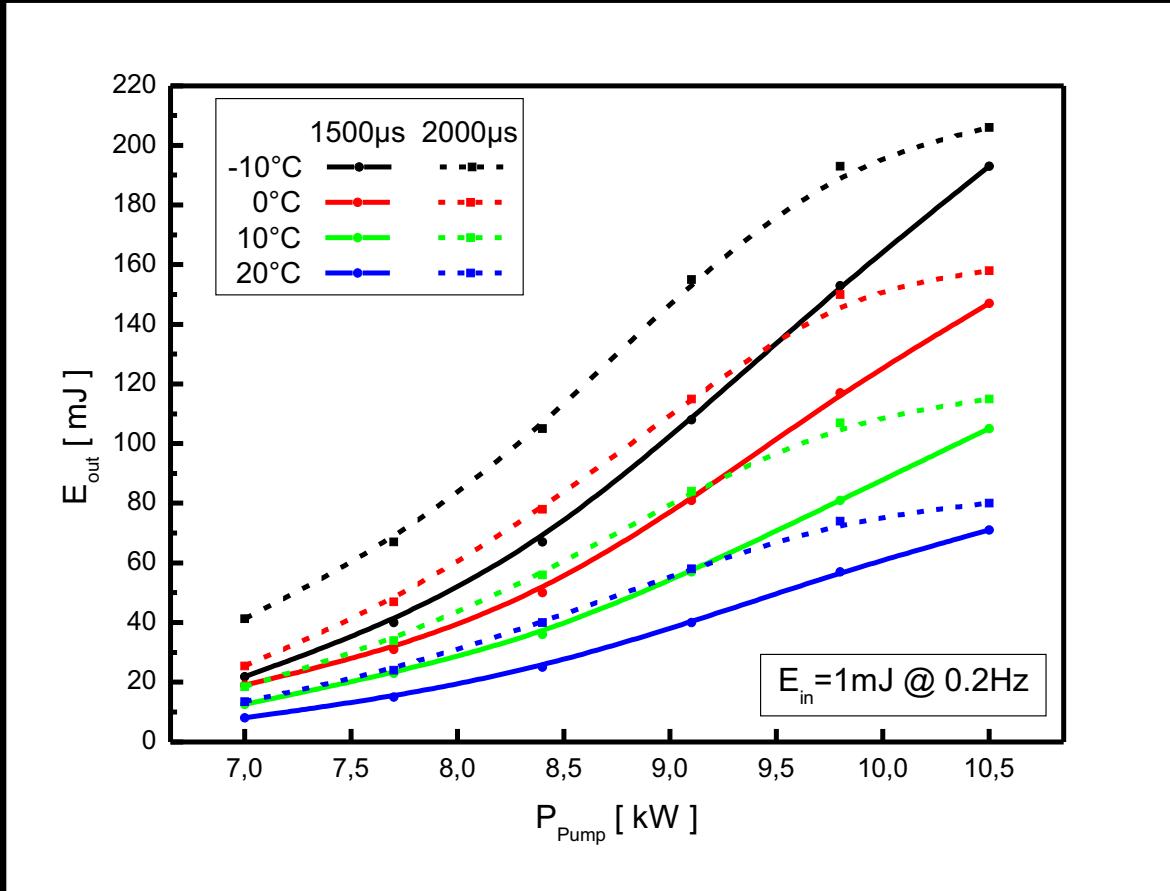
H3 imaging multi-pass - first vacuum tests



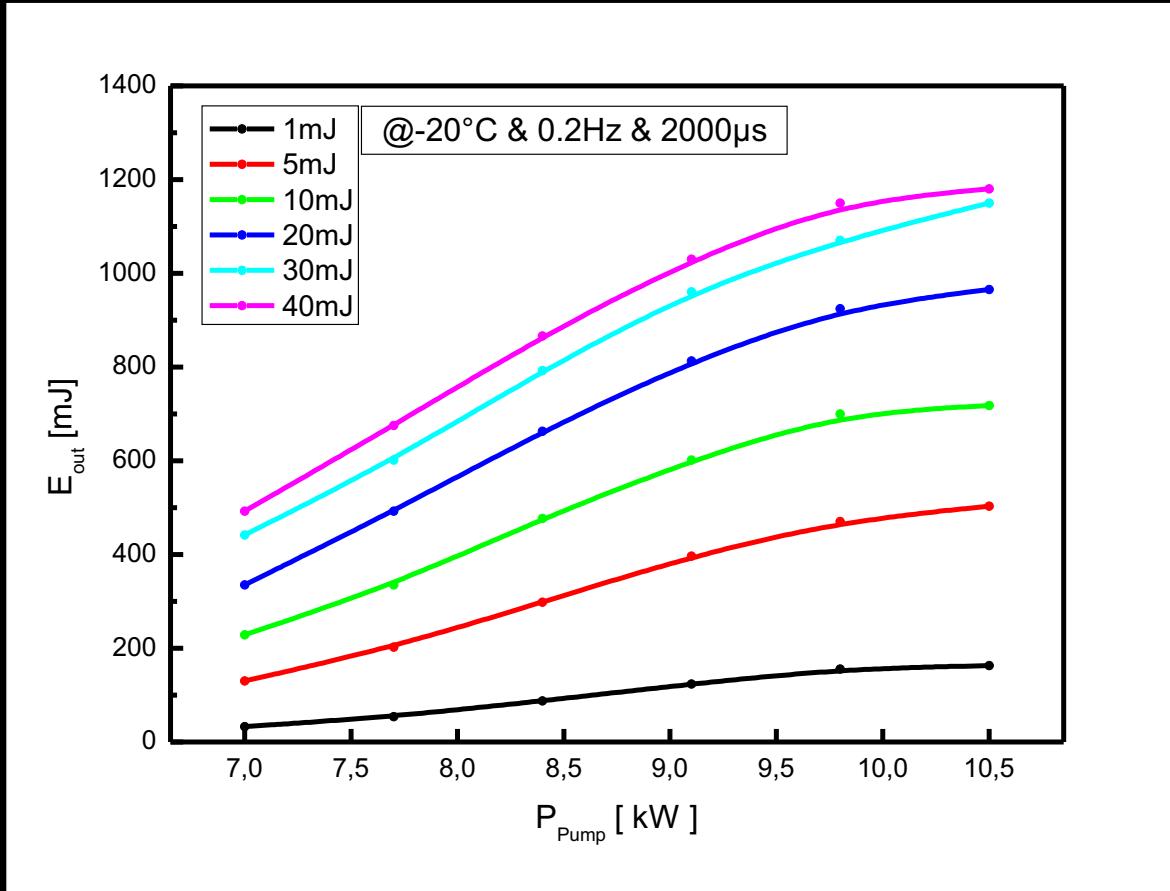
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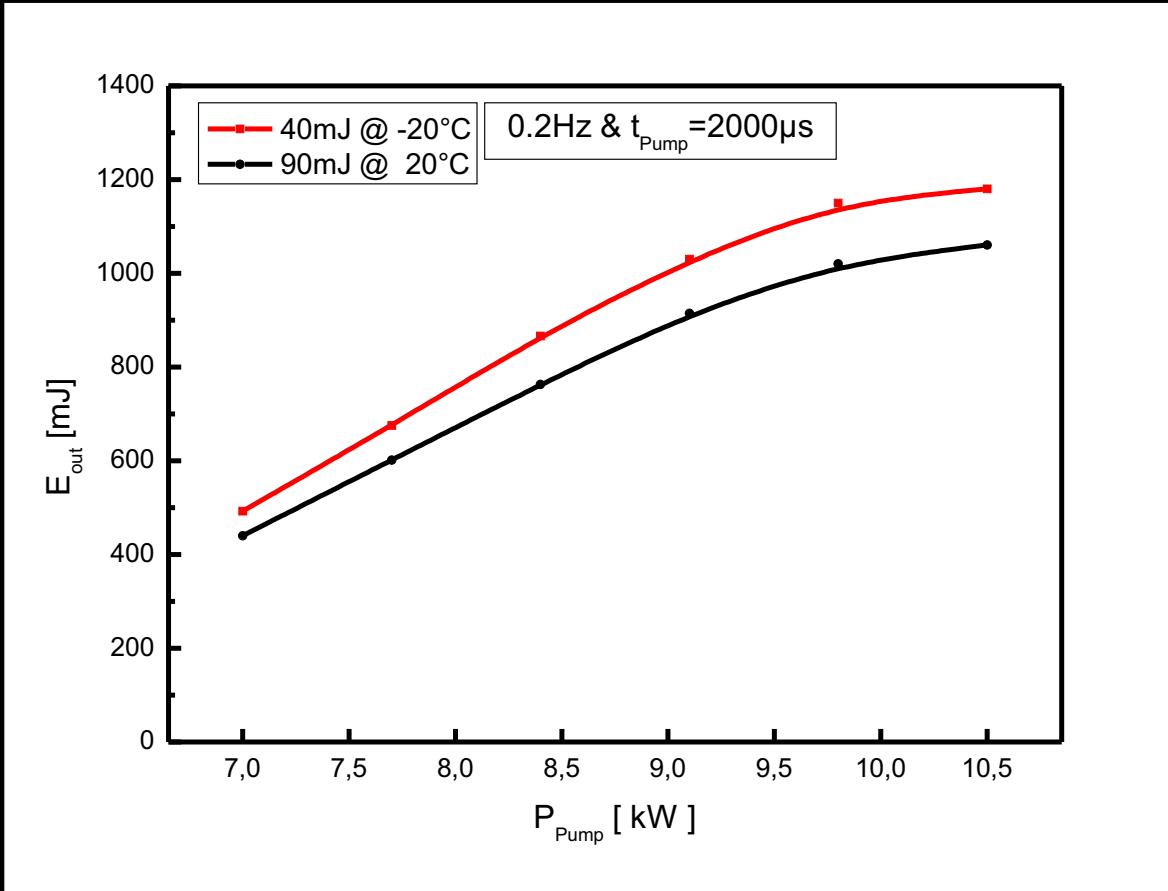
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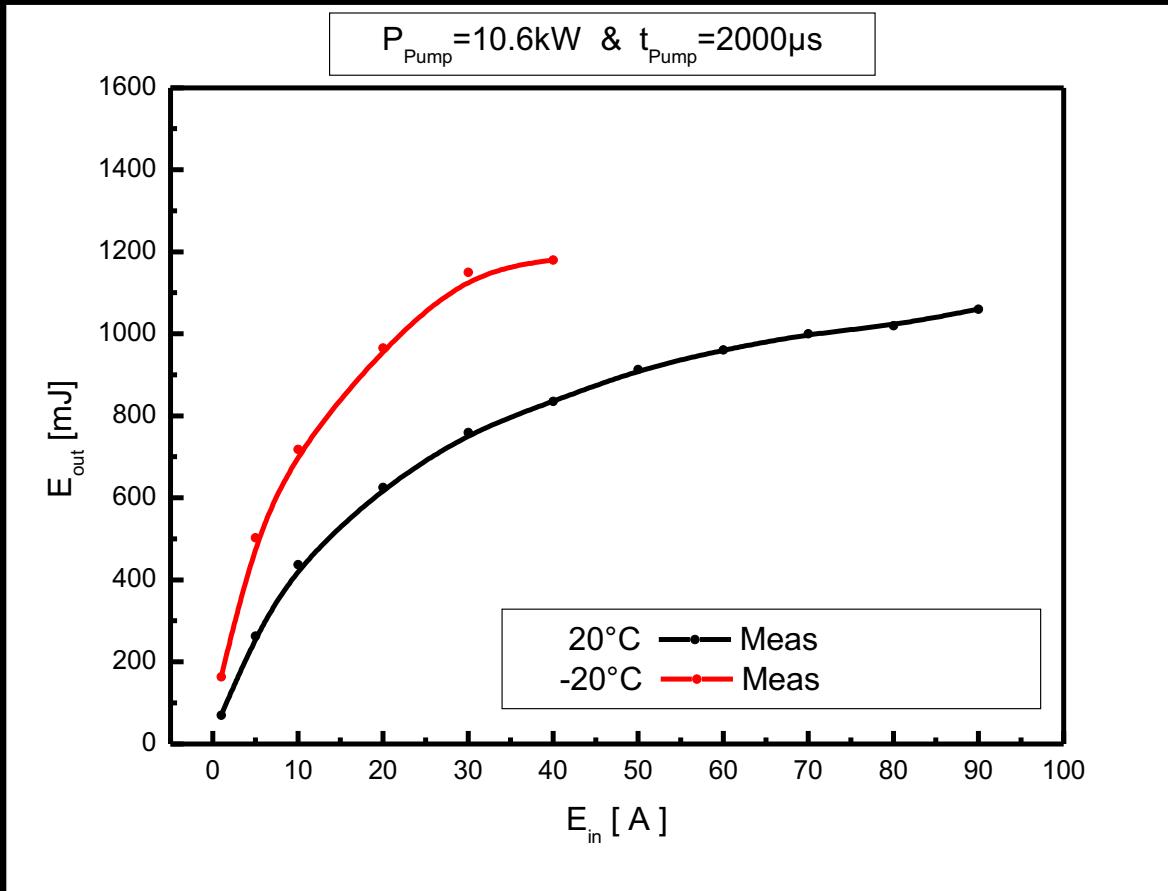
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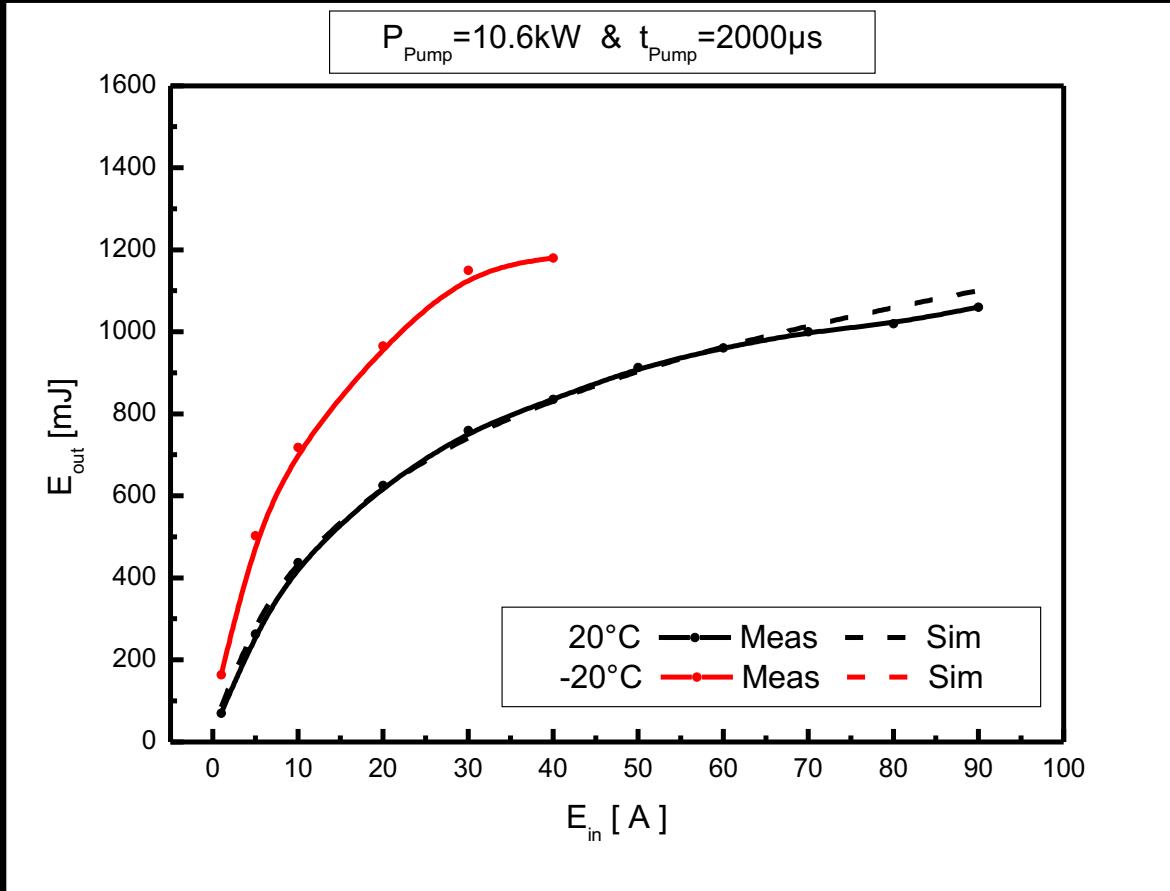
H3 imaging multi-pass - first vacuum tests



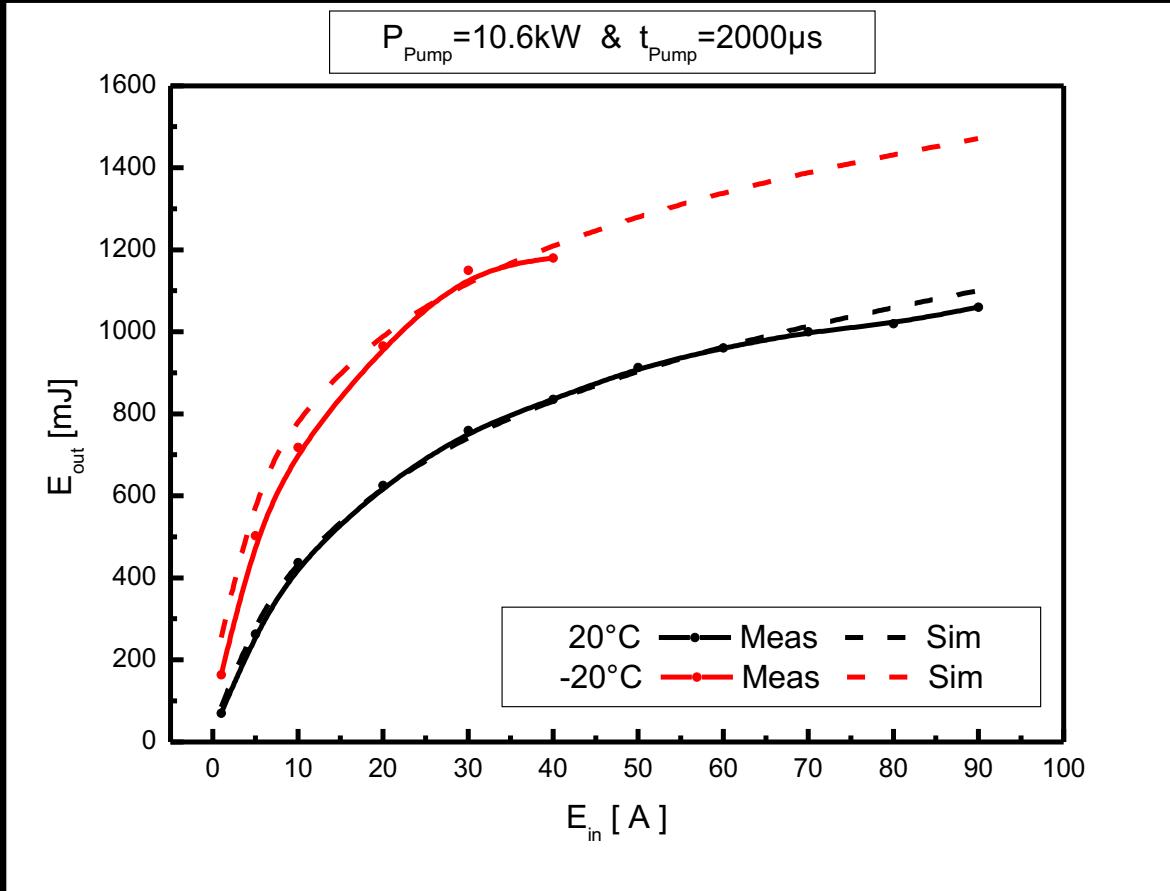
H3 imaging multi-pass - first vacuum tests



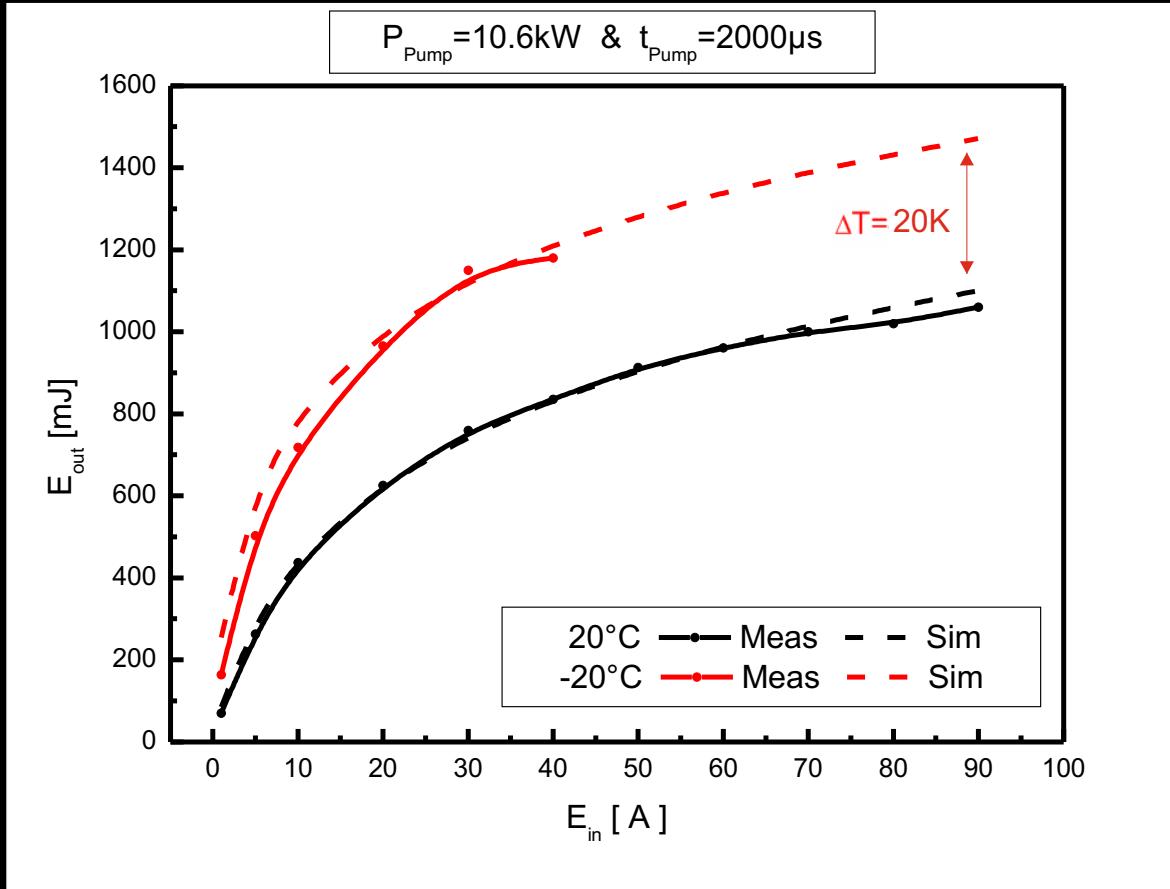
H3 imaging multi-pass - first vacuum tests



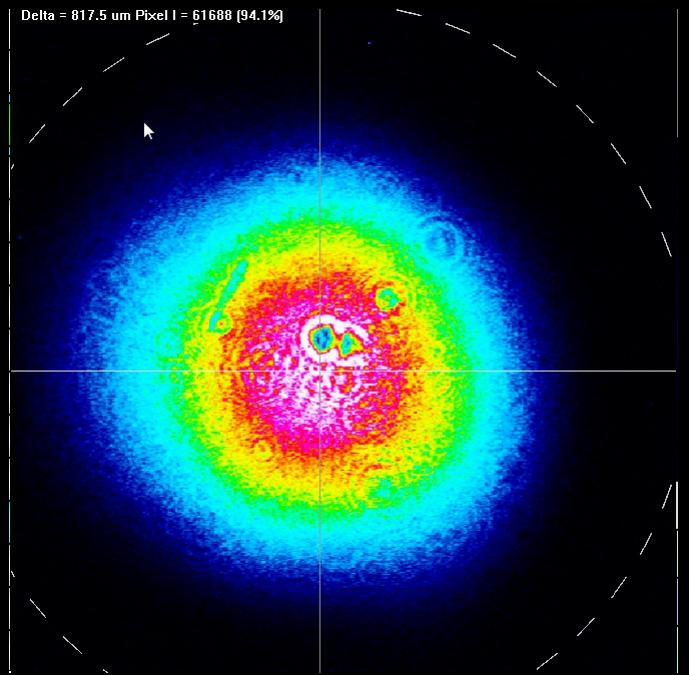
H3 imaging multi-pass - first vacuum tests



H3 imaging multi-pass - first vacuum tests

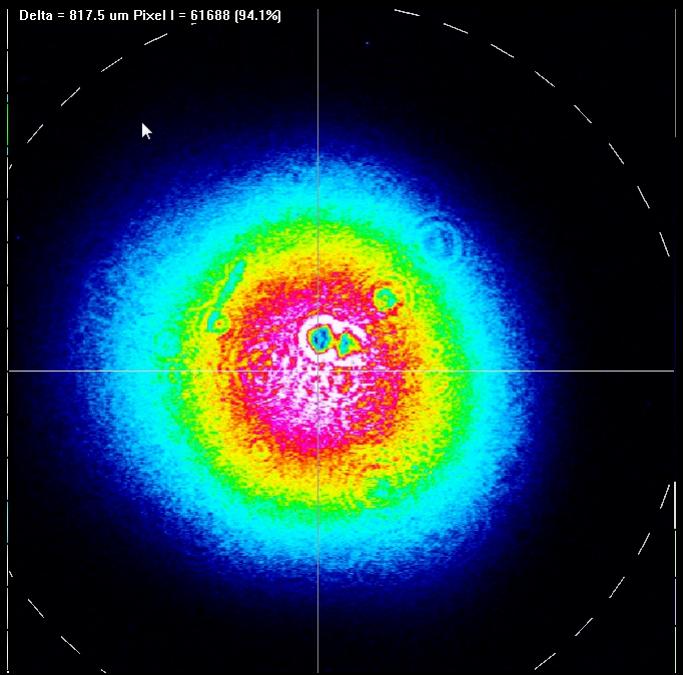
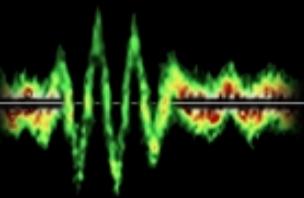


H3 imaging multi-pass - first vacuum tests

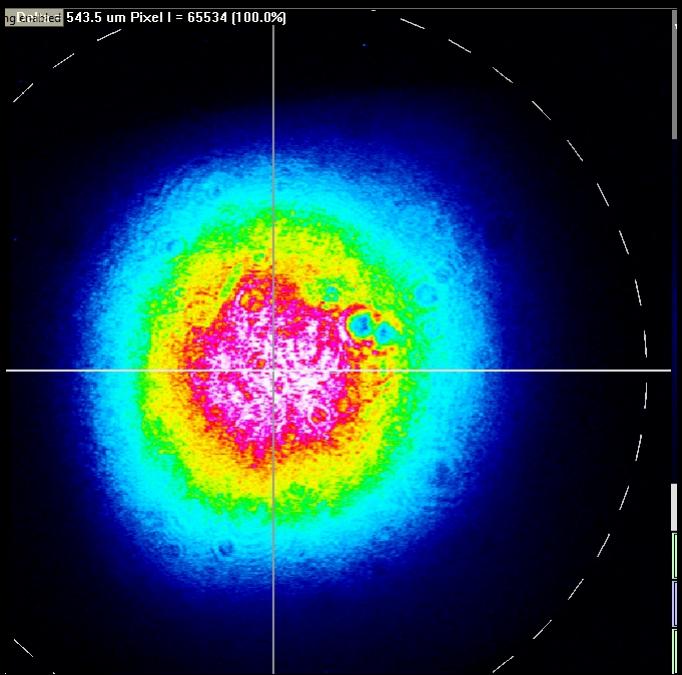


input plane

H3 imaging multi-pass - first vacuum tests

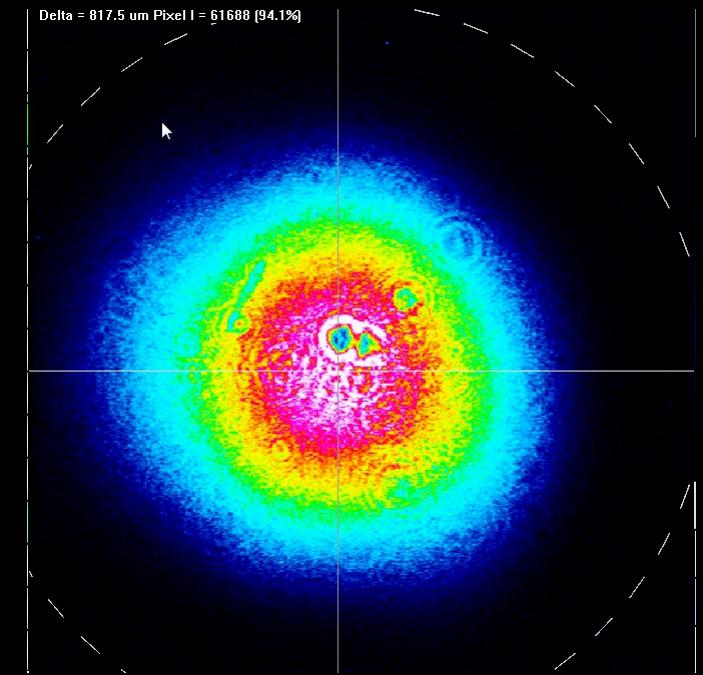


input plane

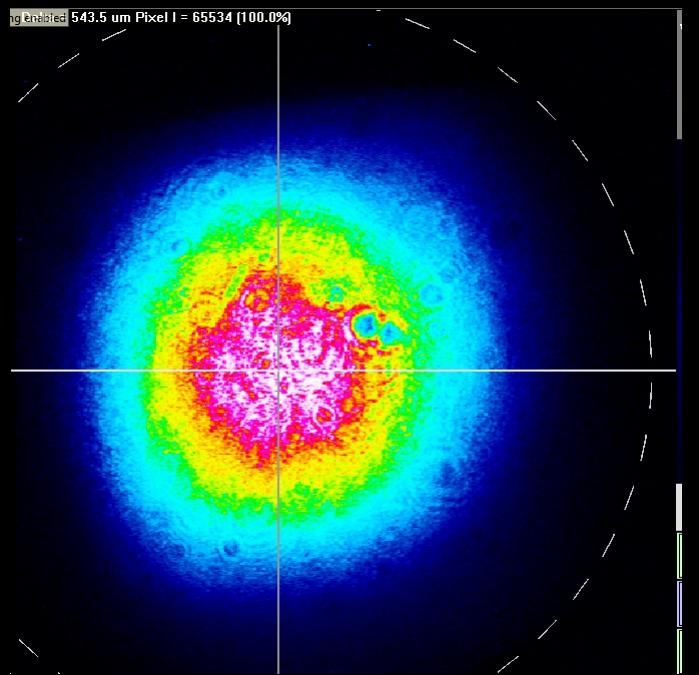


output plane

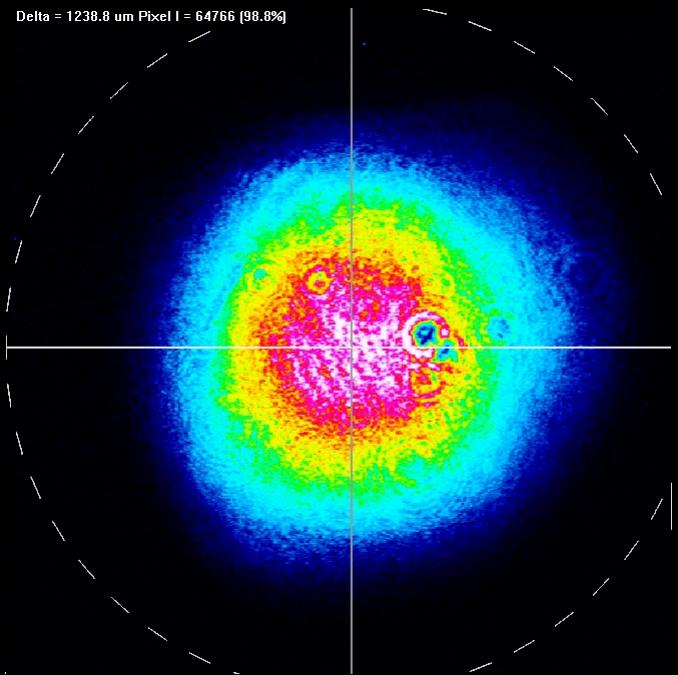
H3 imaging multi-pass - first vacuum tests



input plane

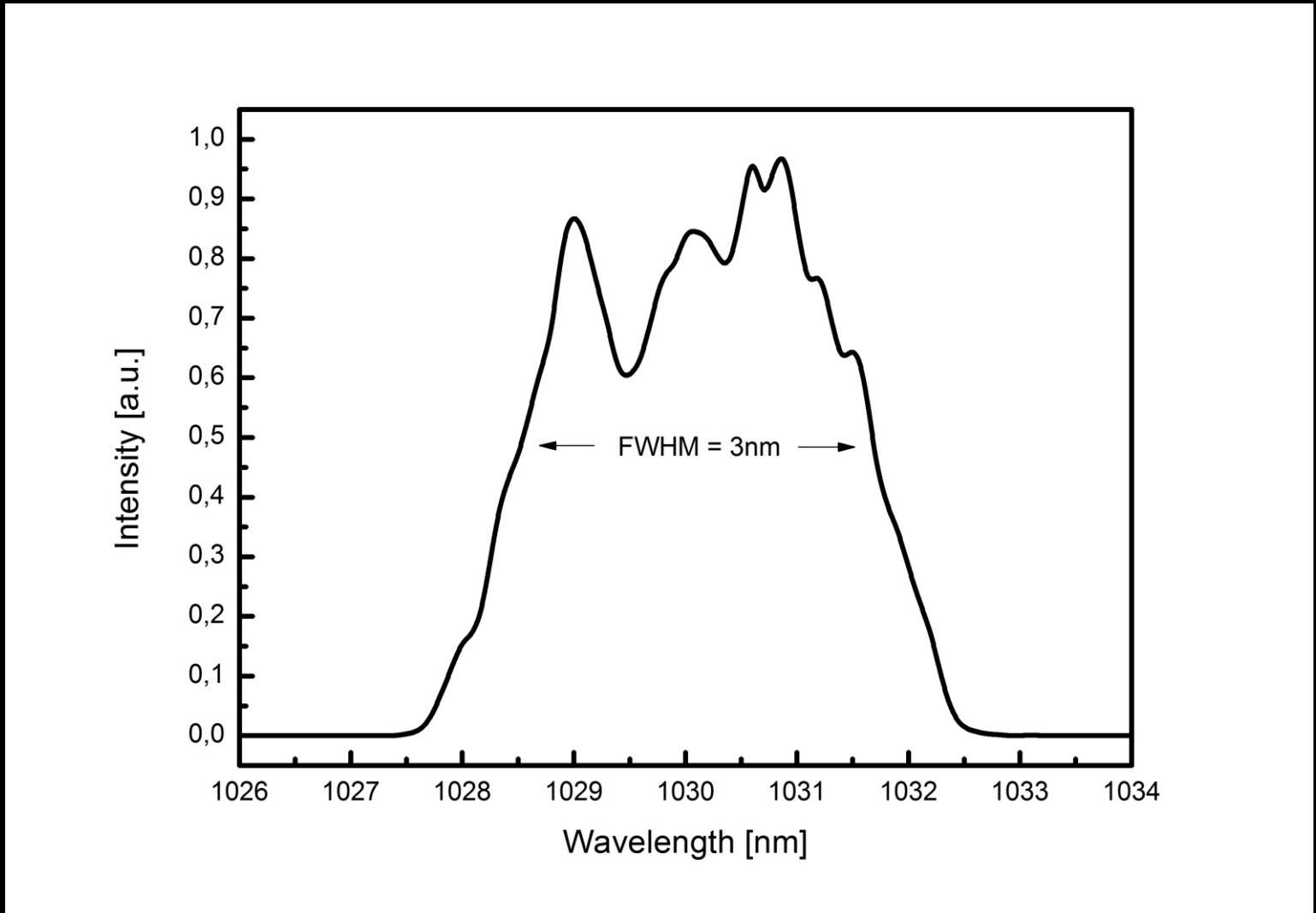


output plane

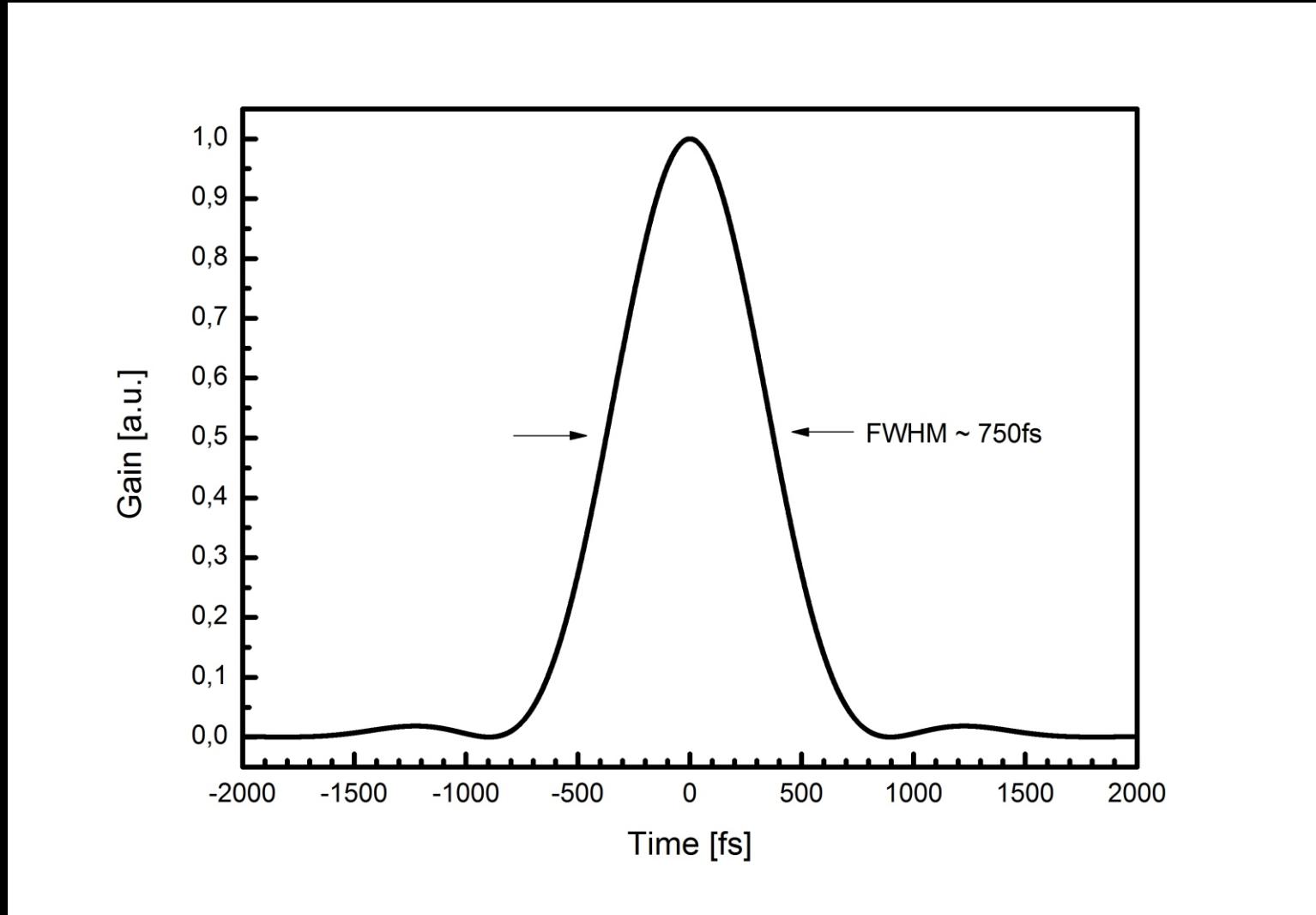


output plane amplified

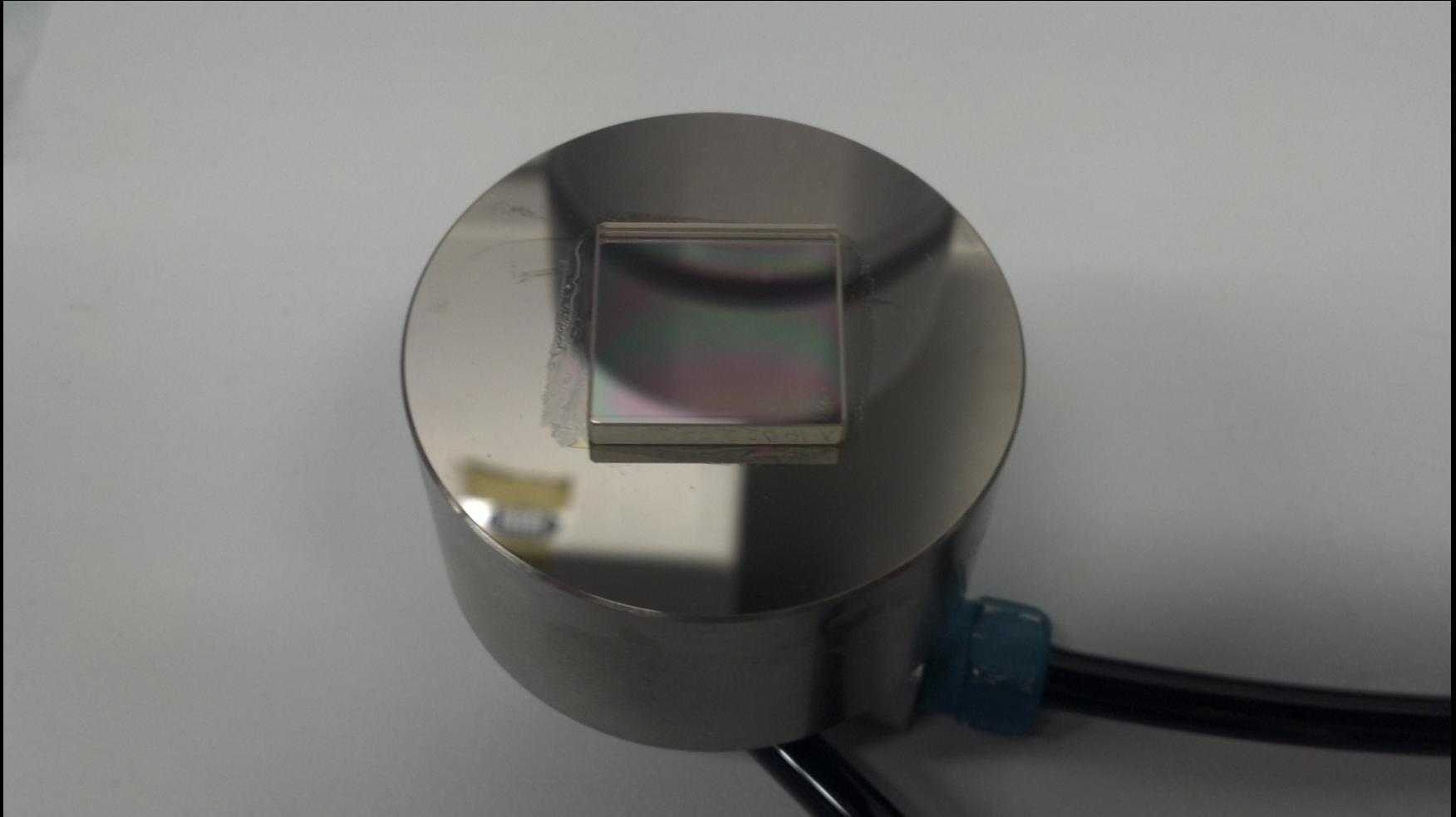
H3 imaging multi-pass - first vacuum tests



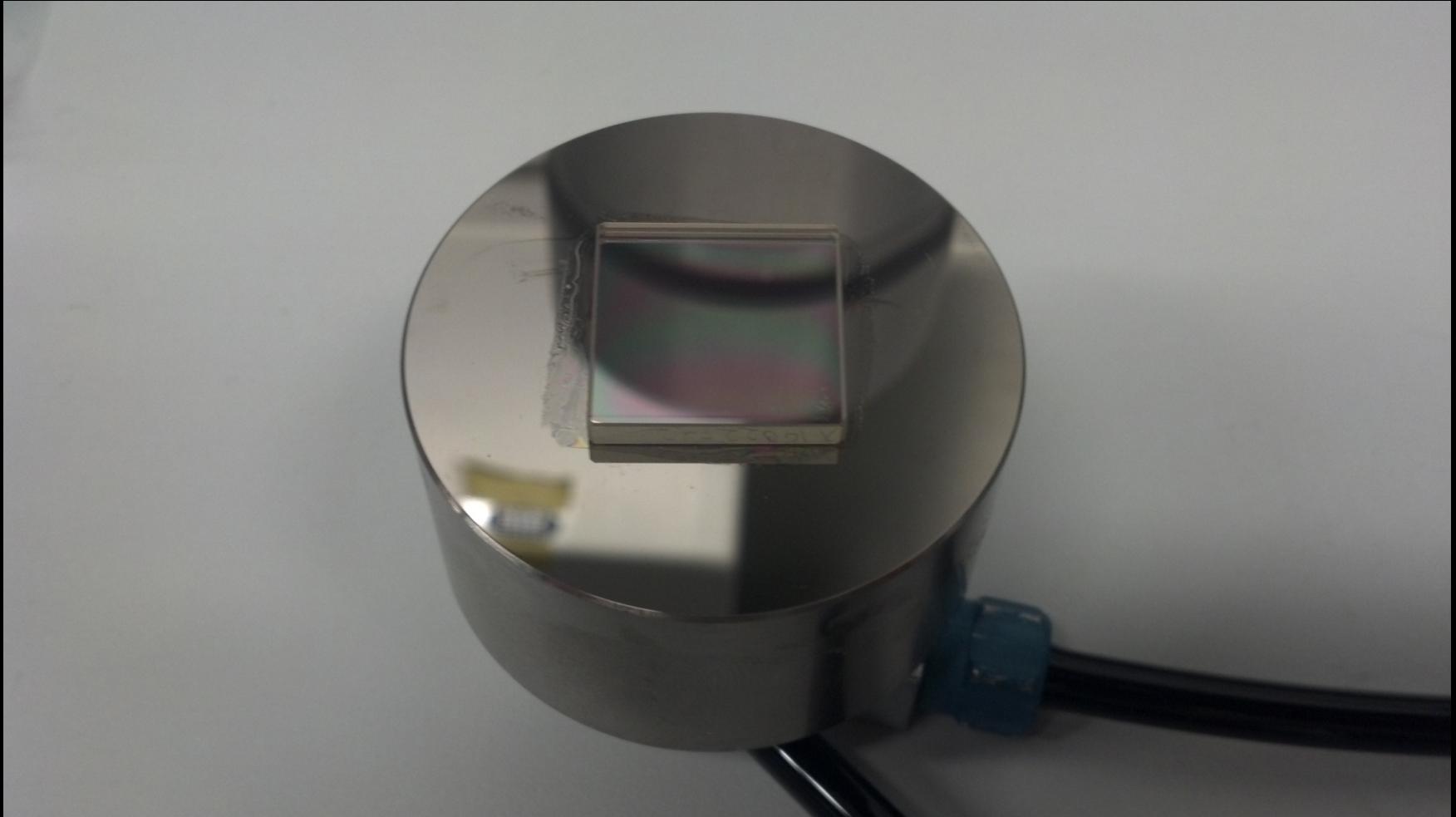
H3 imaging multi-pass - first vacuum tests



H3 imaging multi-pass - new crystals

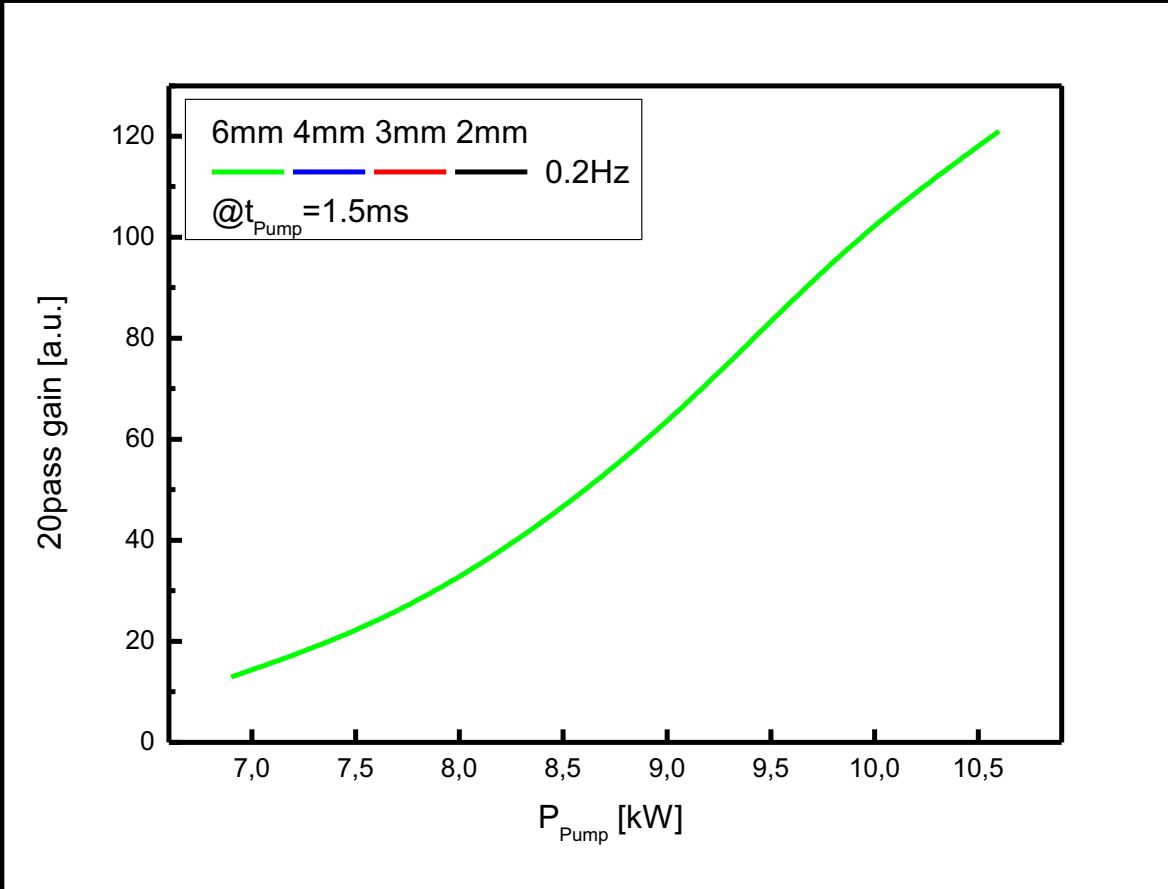


H3 imaging multi-pass - new crystals

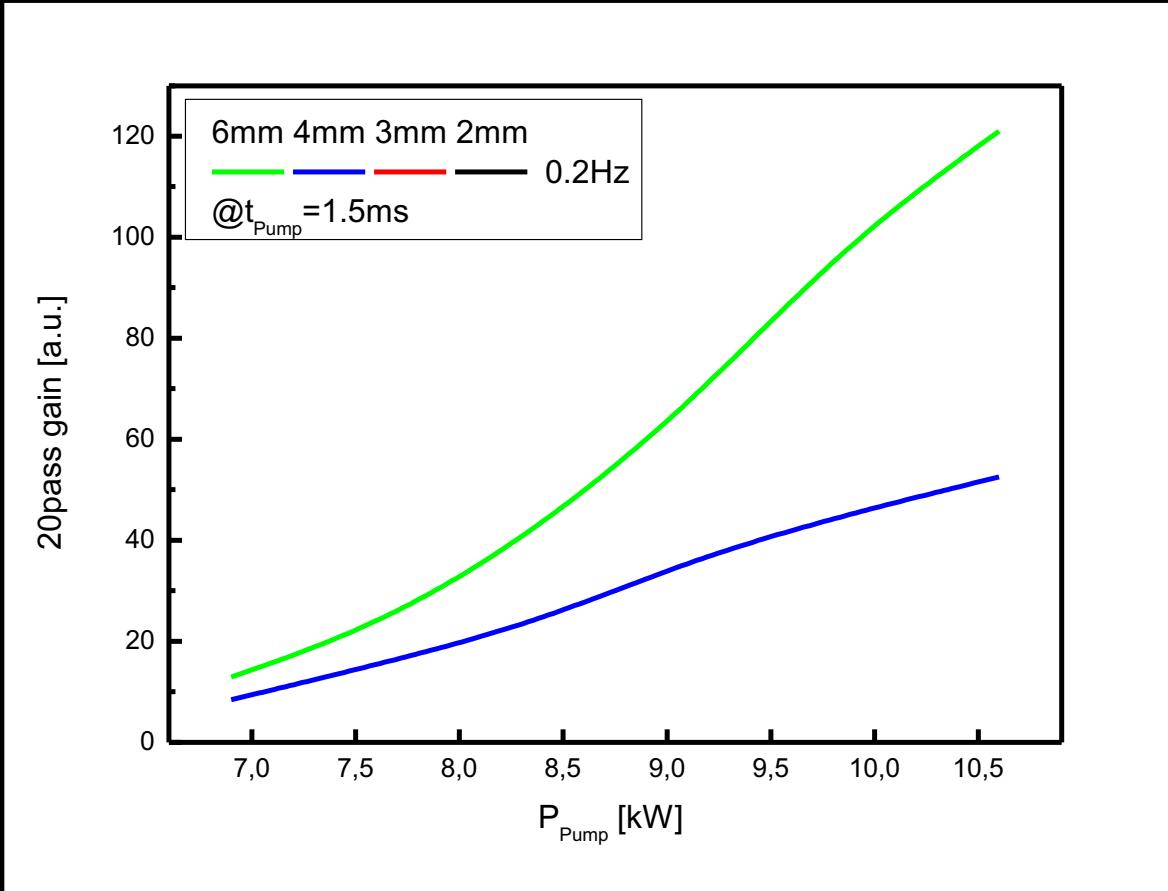


6mmx2%dop., 4mmx4%dop., 3mmx6%dop., 2mmx8%dop.

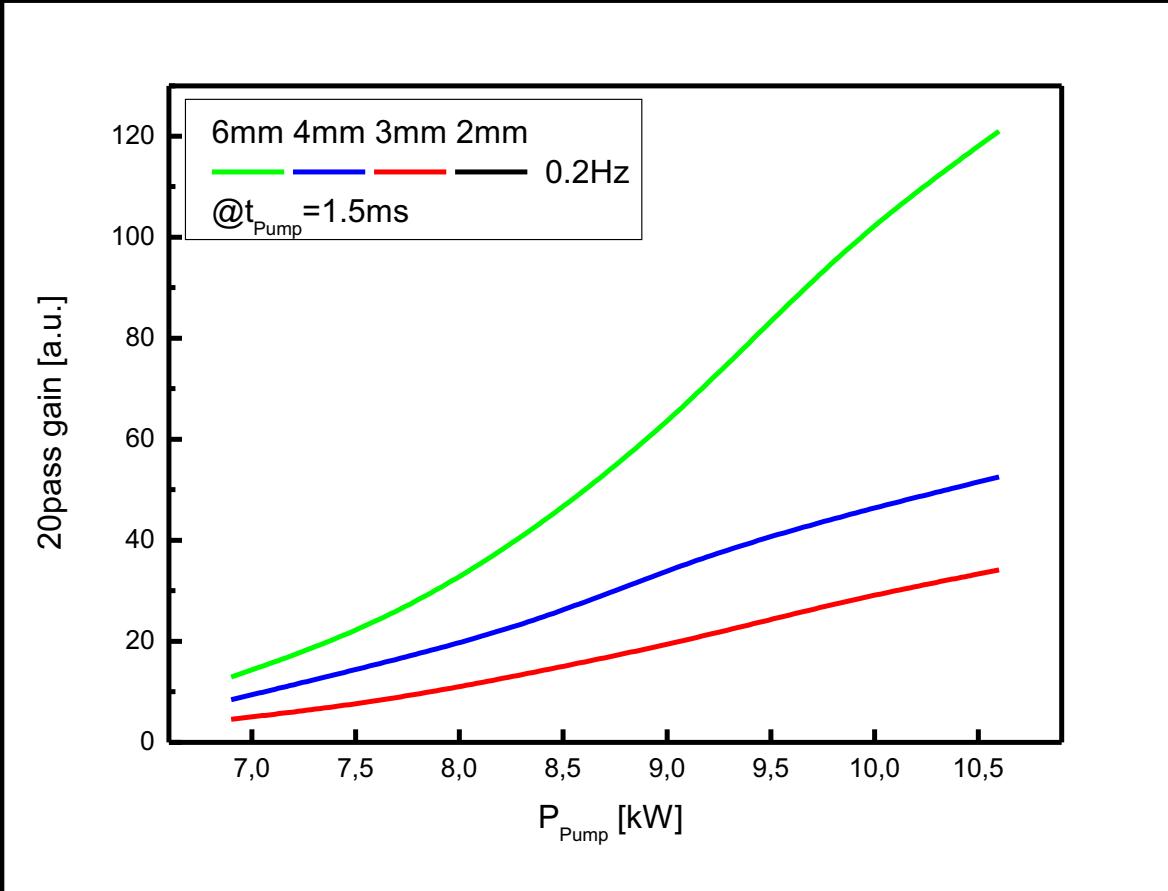
H3 imaging multi-pass - small signal gain



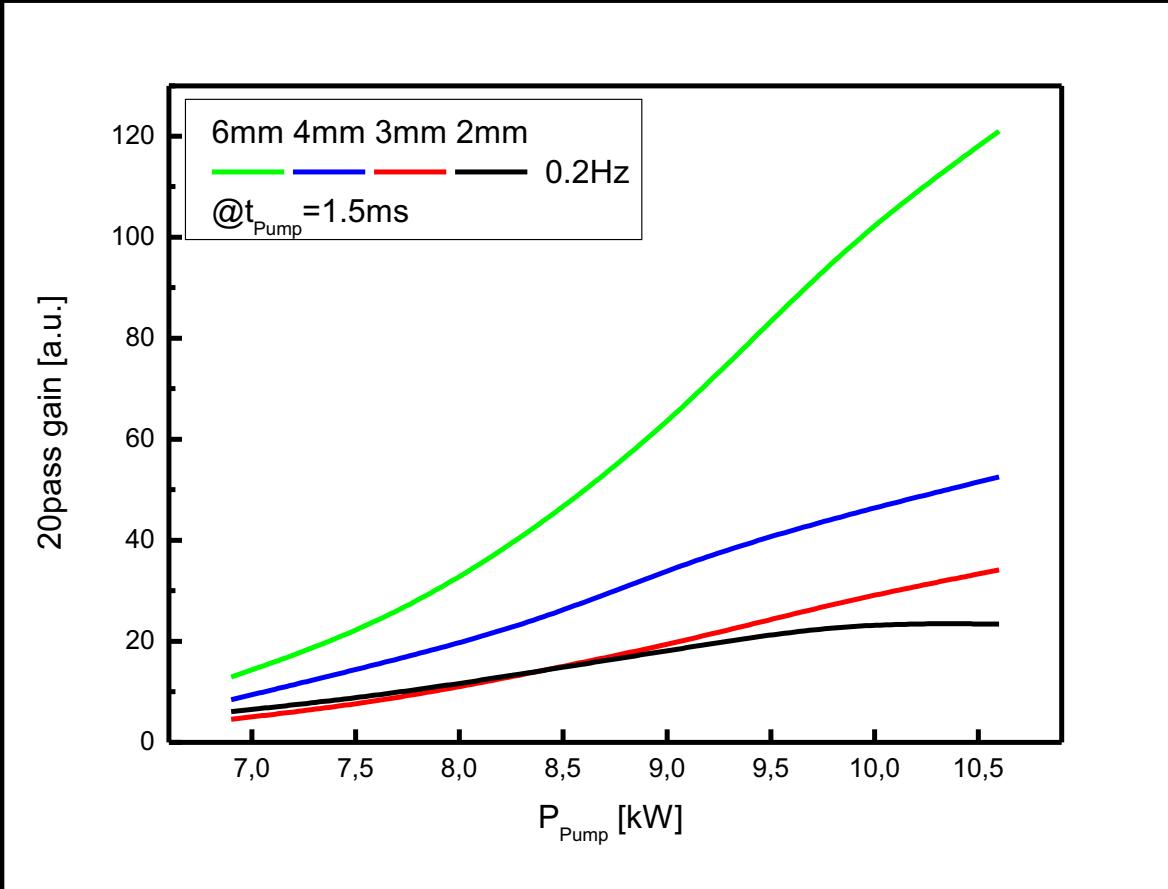
H3 imaging multi-pass - small signal gain



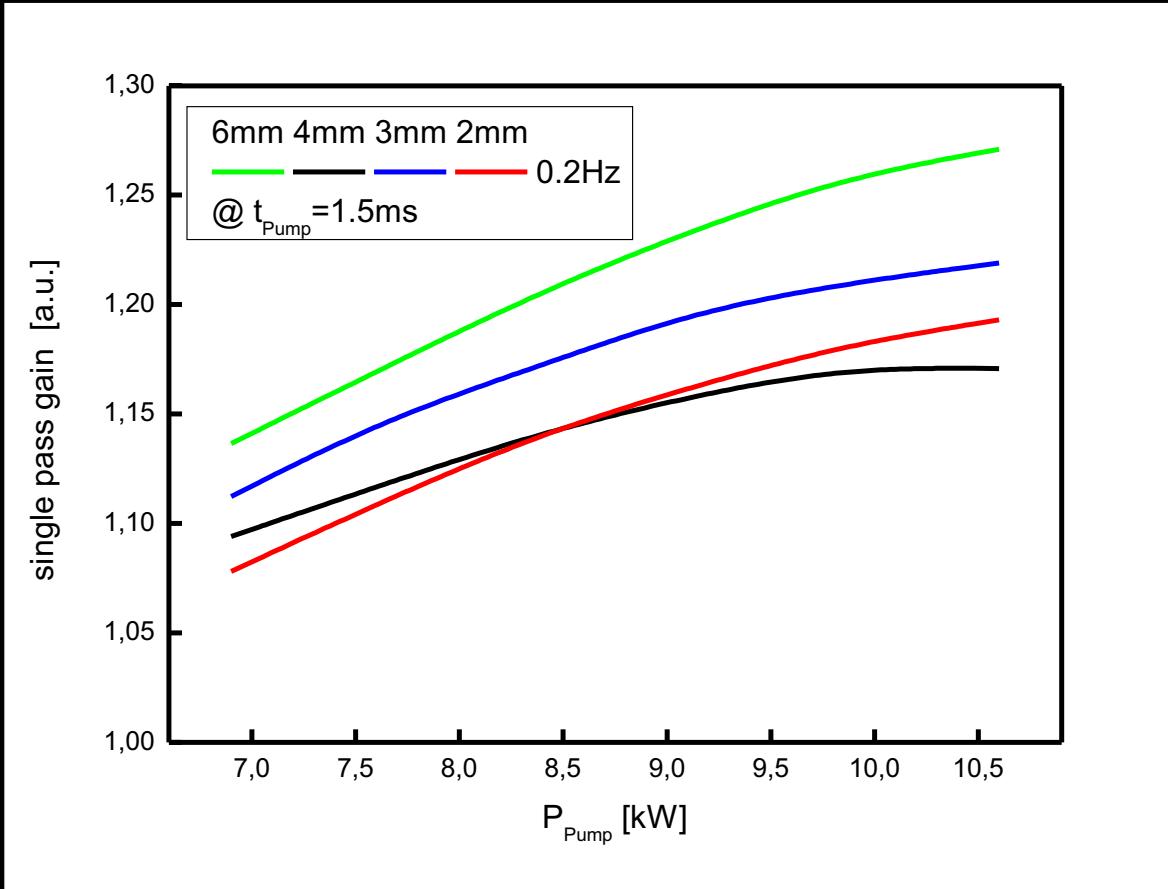
H3 imaging multi-pass - small signal gain



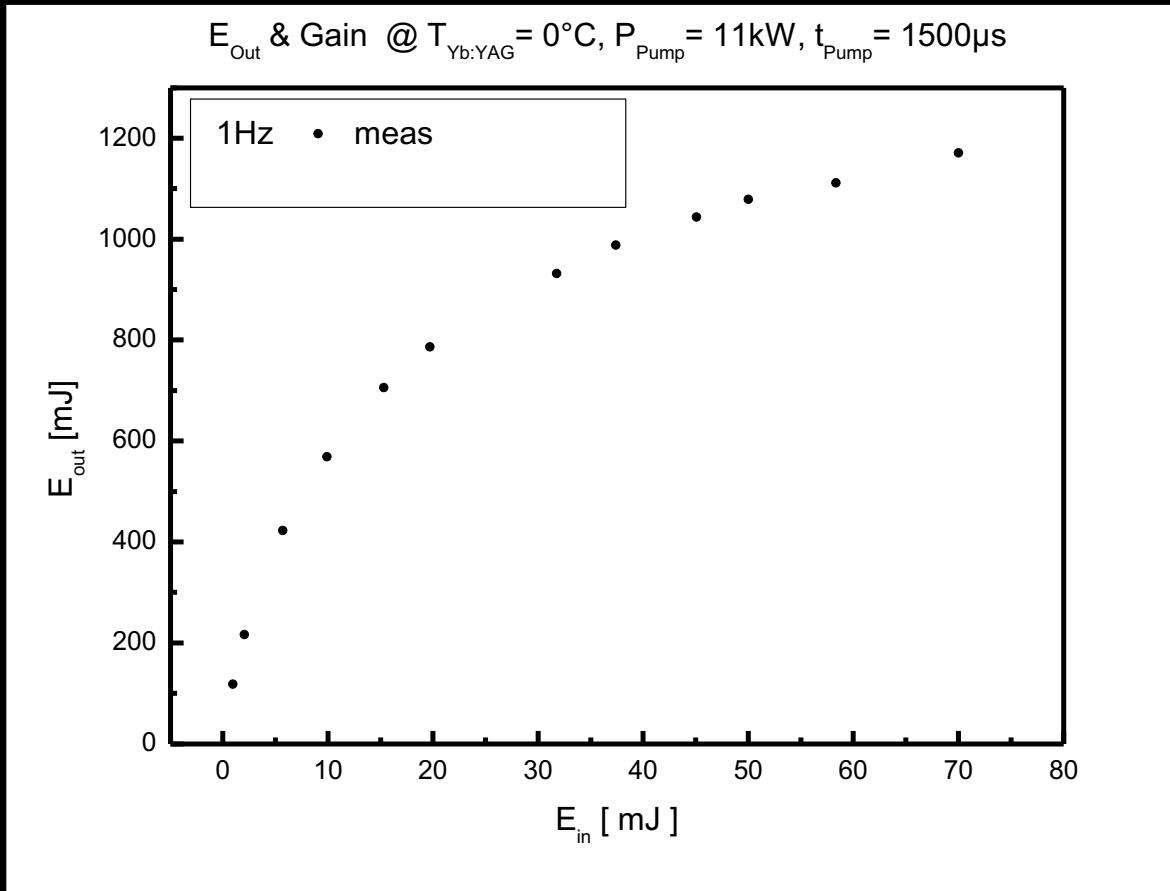
H3 imaging multi-pass - small signal gain



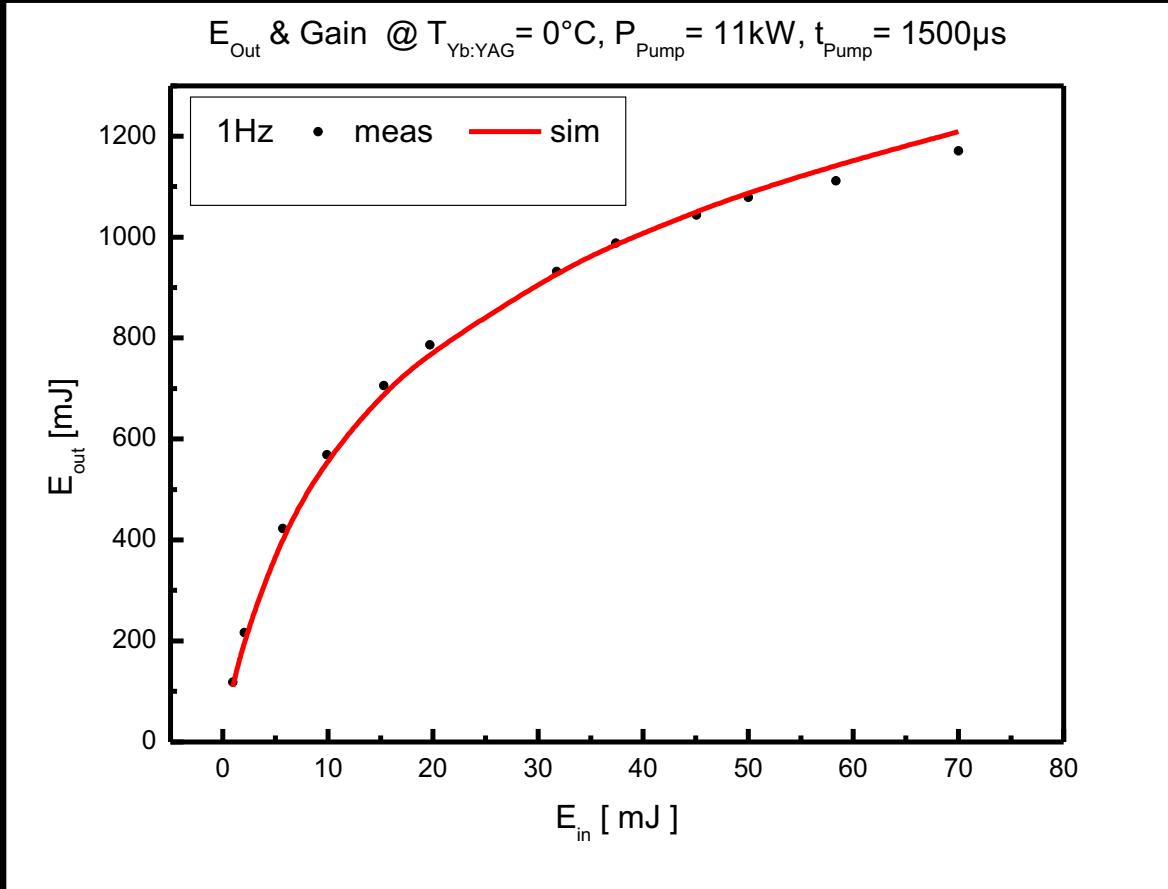
H3 imaging multi-pass - small signal gain



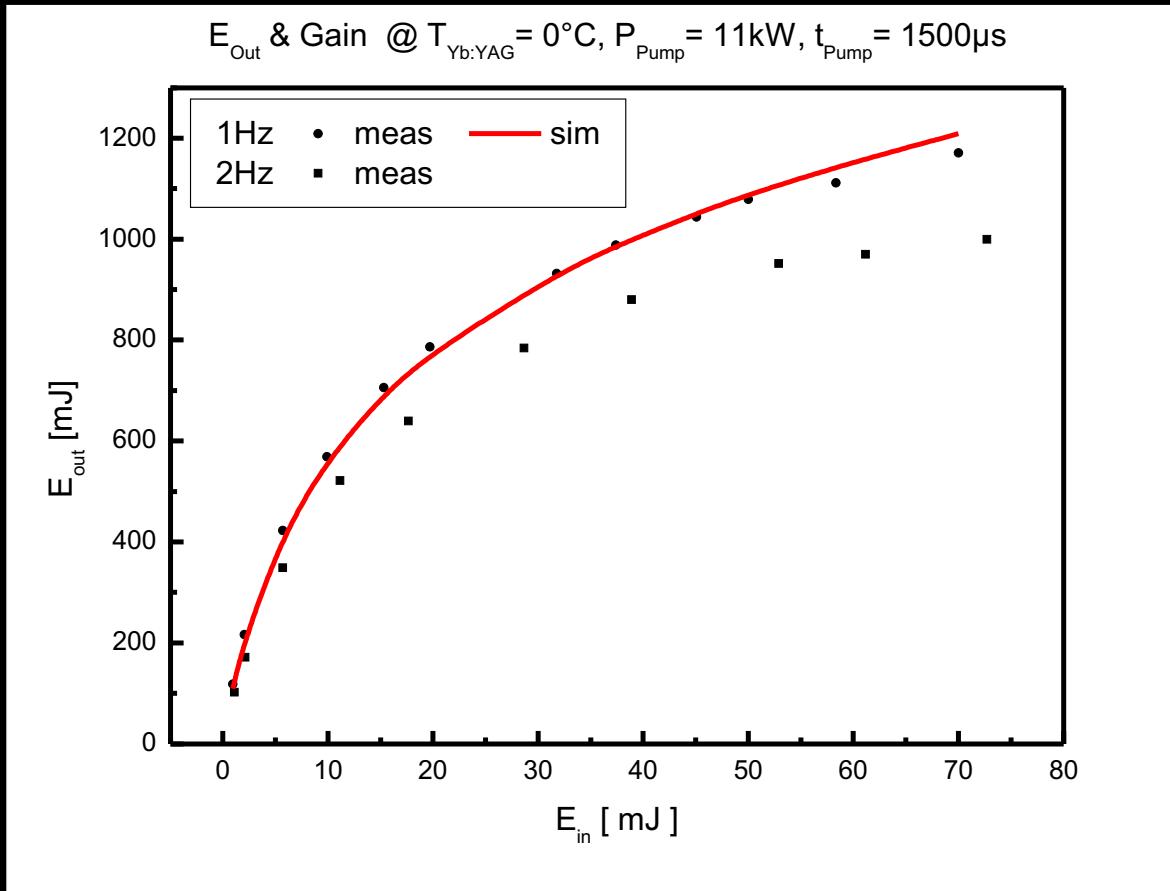
H3 imaging multi-pass - saturated gain - 6mm x 2% dop.



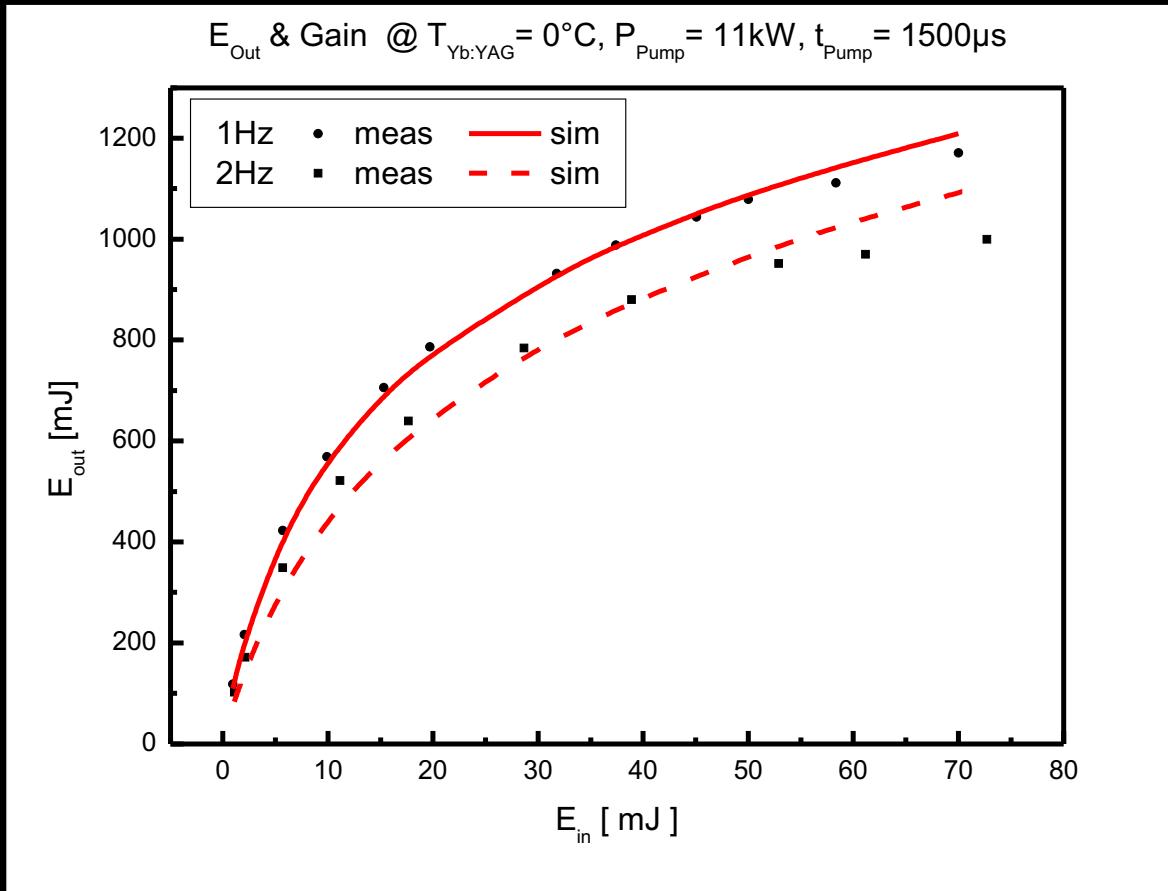
H3 imaging multi-pass - saturated gain - 6mm x 2% dop.



H3 imaging multi-pass - saturated gain - 6mm x 2% dop.



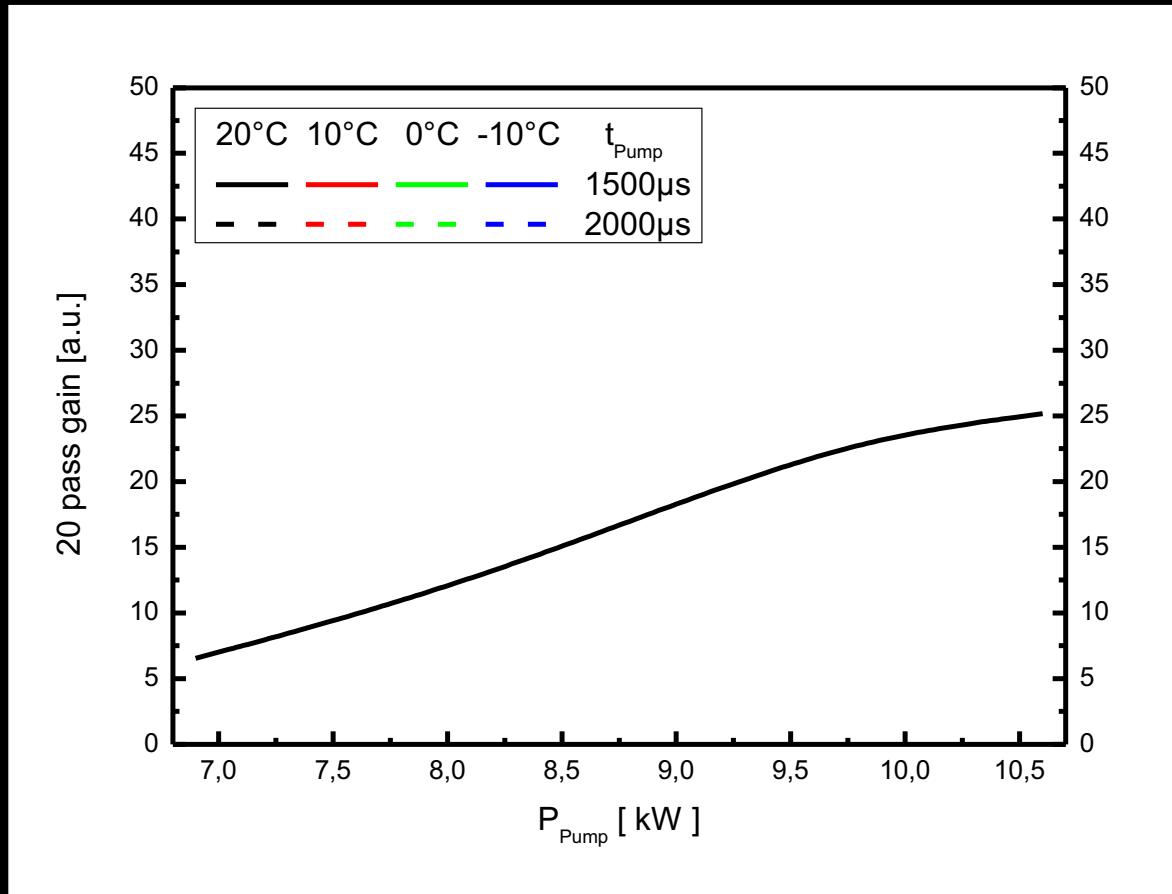
H3 imaging multi-pass - saturated gain - 6mm x 2% dop.



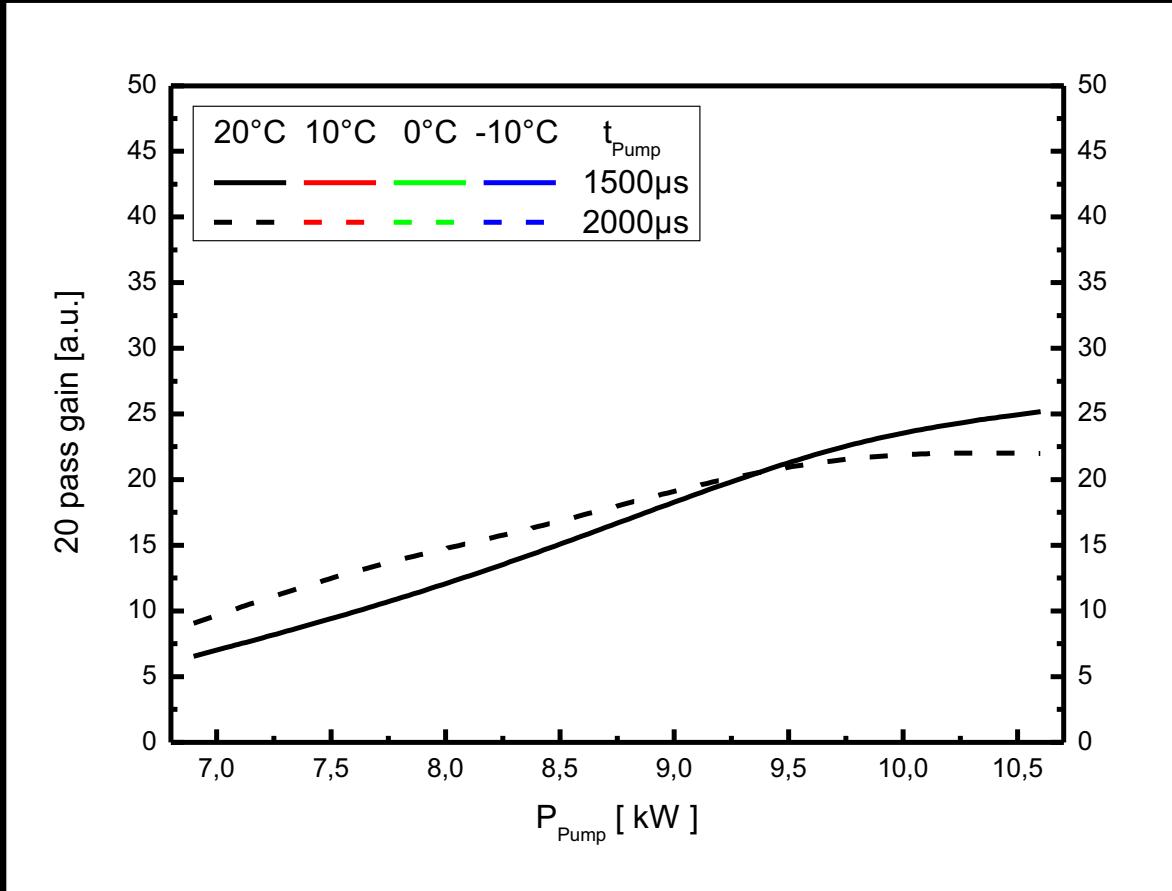


H3 imaging multi-pass - para. oscill.? - 2mm x 8% dop.

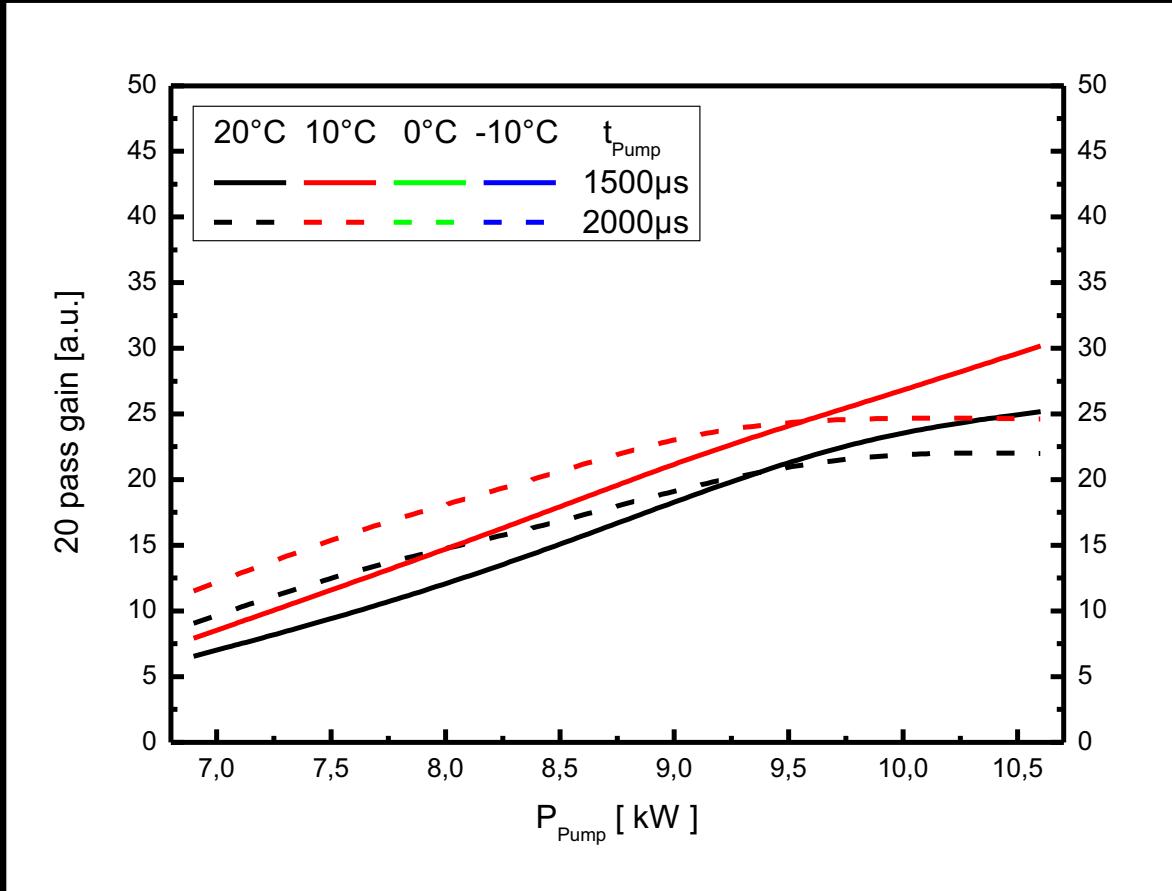
LMU



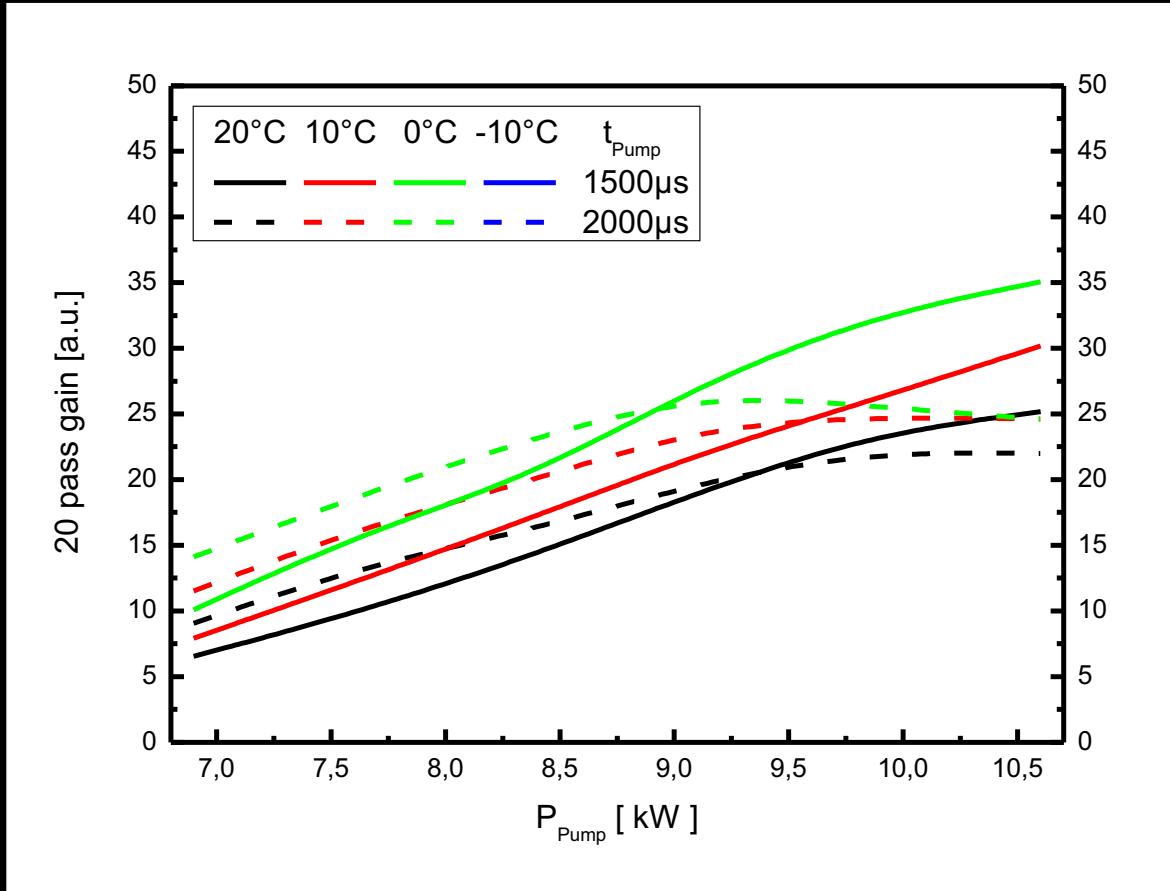
H3 imaging multi-pass - para. oscill.? - 2mm x 8% dop.



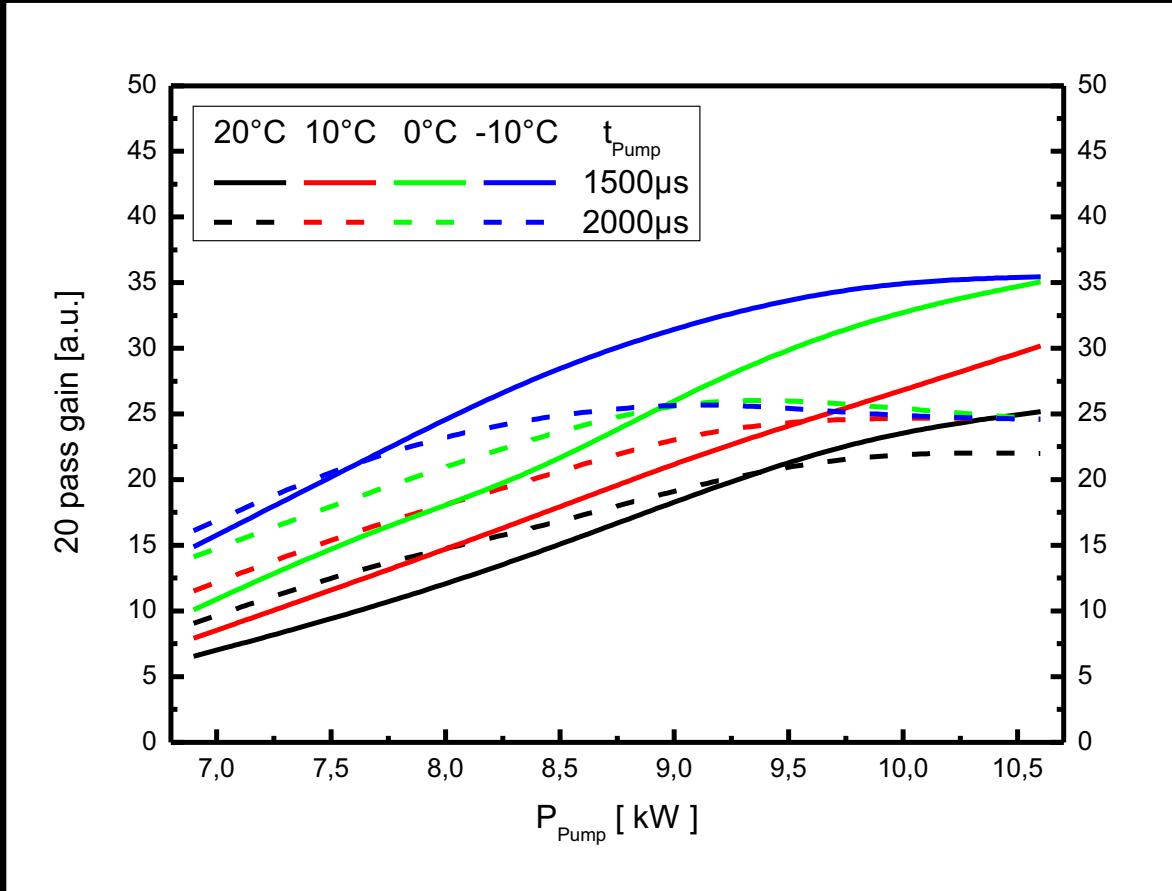
H3 imaging multi-pass - para. oscill.? - 2mm x 8% dop.



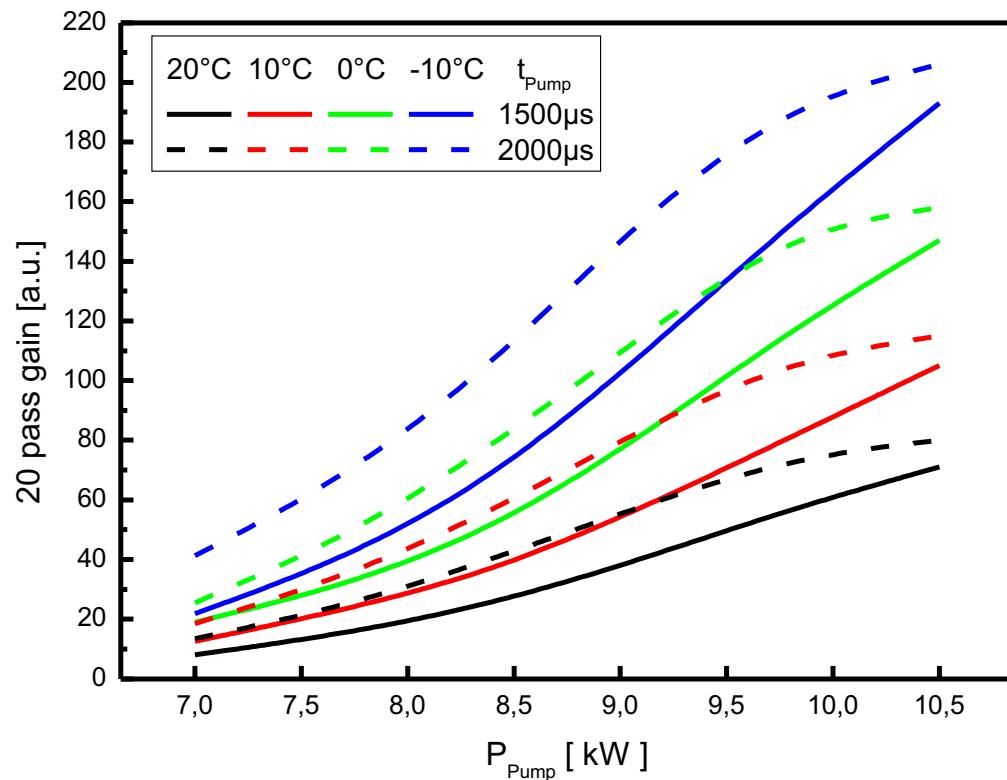
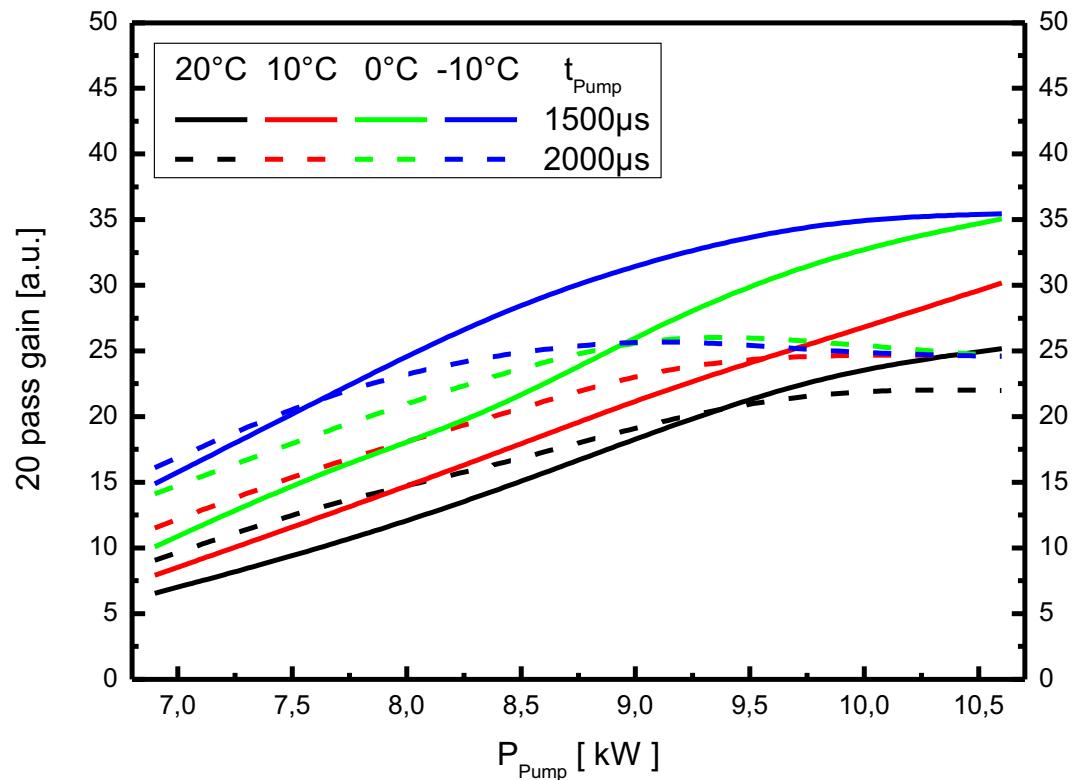
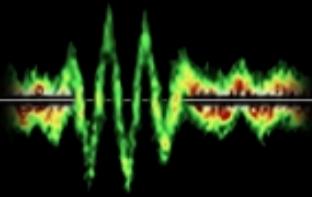
H3 imaging multi-pass - para. oscill.? - 2mm x 8% dop.



H3 imaging multi-pass - para. oscill.? - 2mm x 8% dop.



H3 imaging multi-pass - para. oscill.? - 2mm x 8% dop.



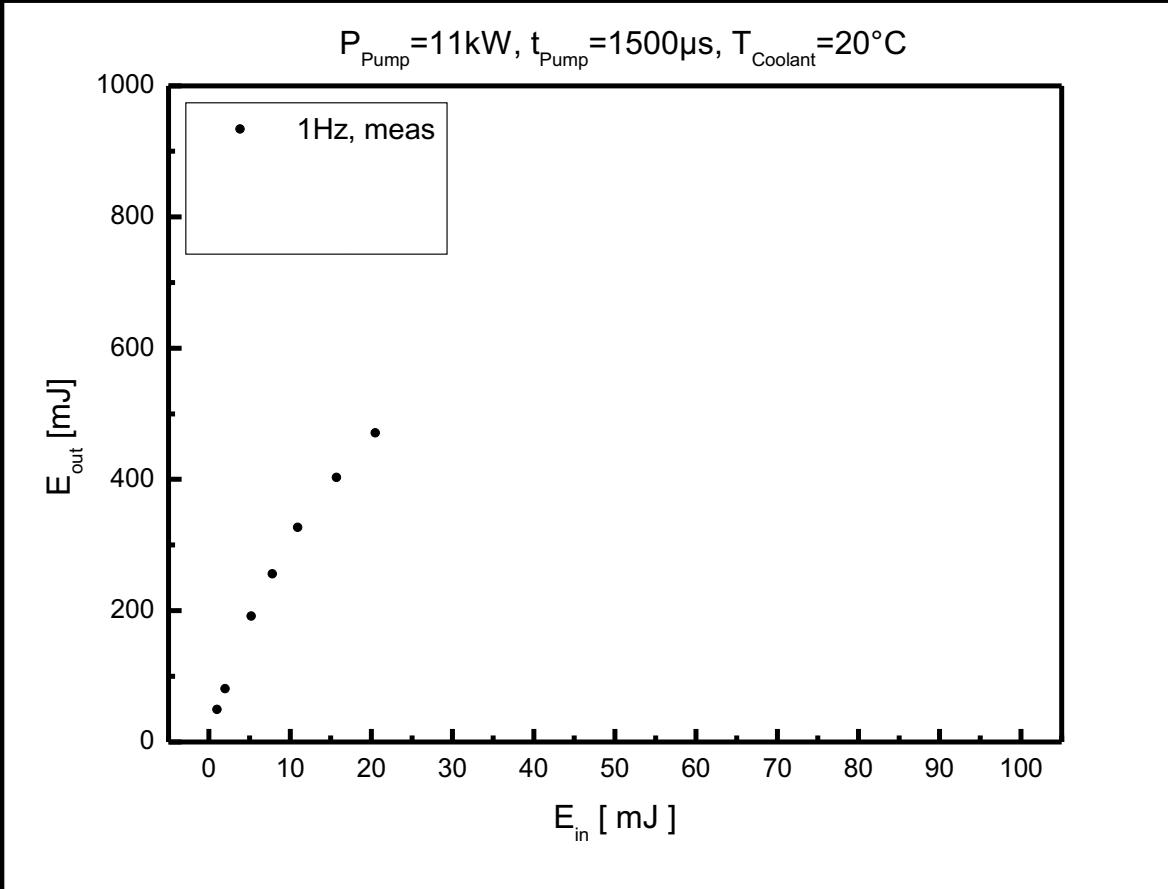
2mmx8%dop.

$g_0^* L \sim 3$

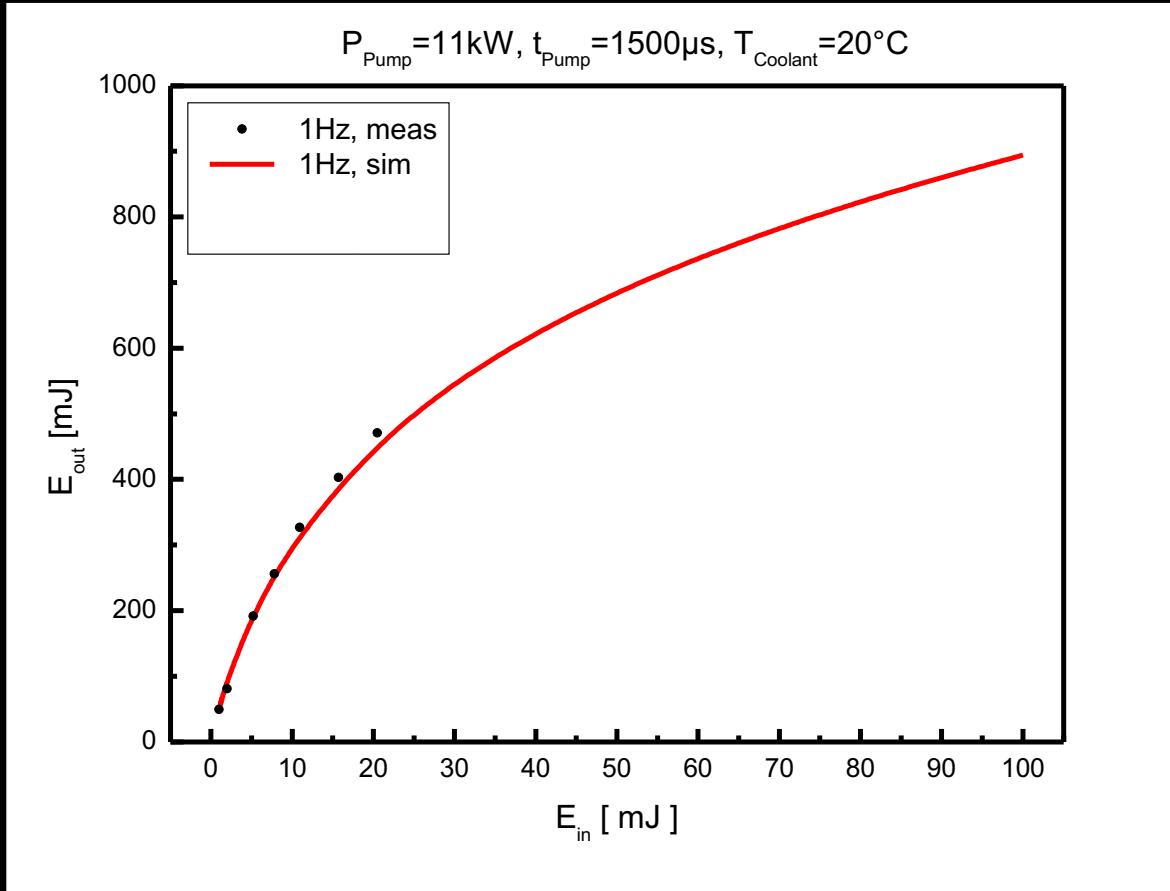
6mmx2%dop.

$g_0^* L \sim 1$

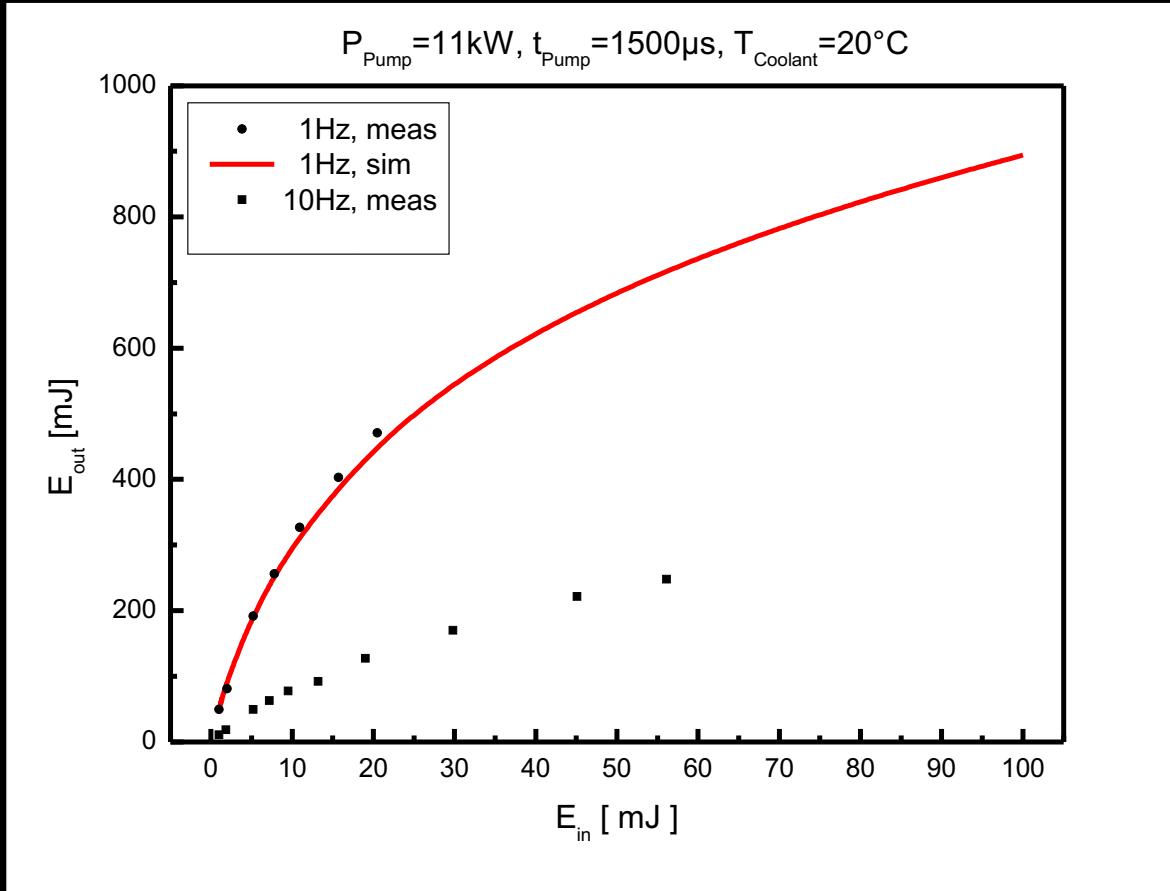
H3 imaging multi-pass - new chiller - 6mm x 2% dop.



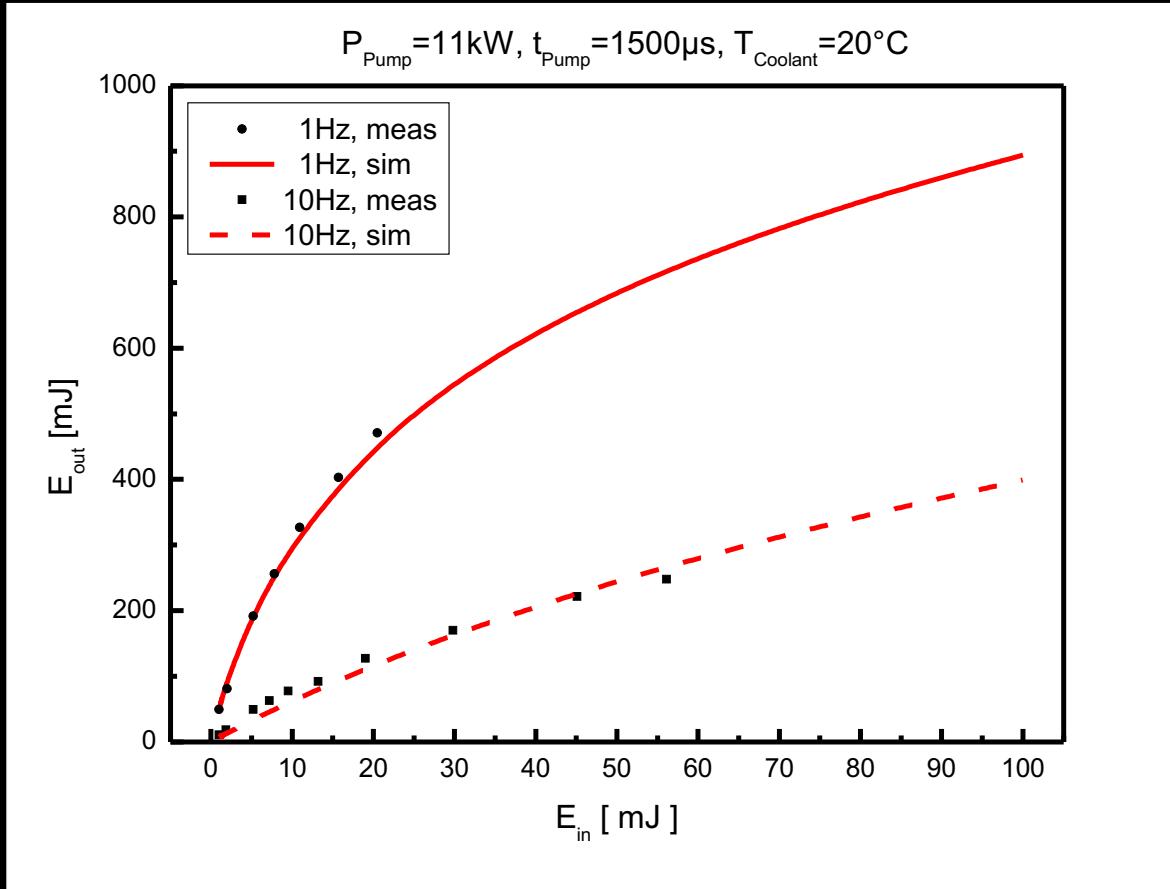
H3 imaging multi-pass - new chiller - 6mm x 2% dop.



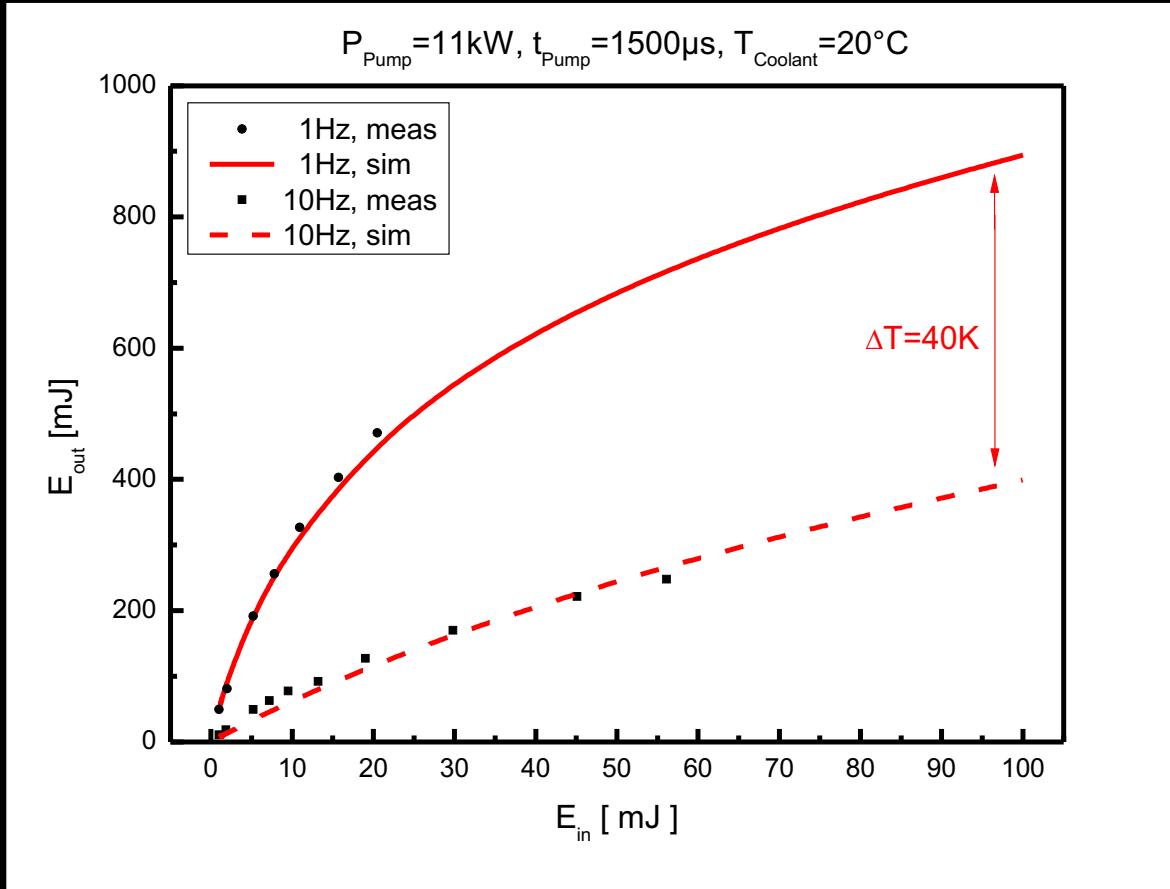
H3 imaging multi-pass - new chiller - 6mm x 2% dop.



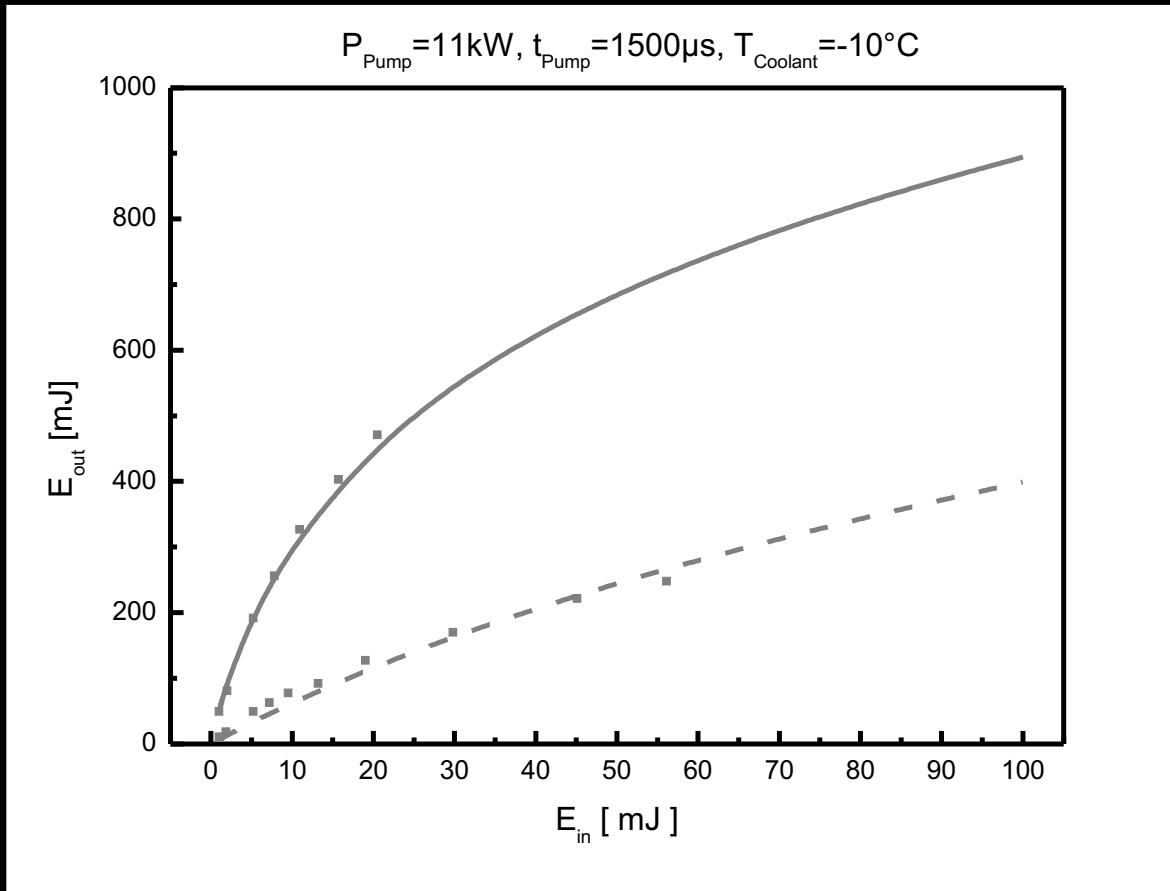
H3 imaging multi-pass - new chiller - 6mm x 2% dop.



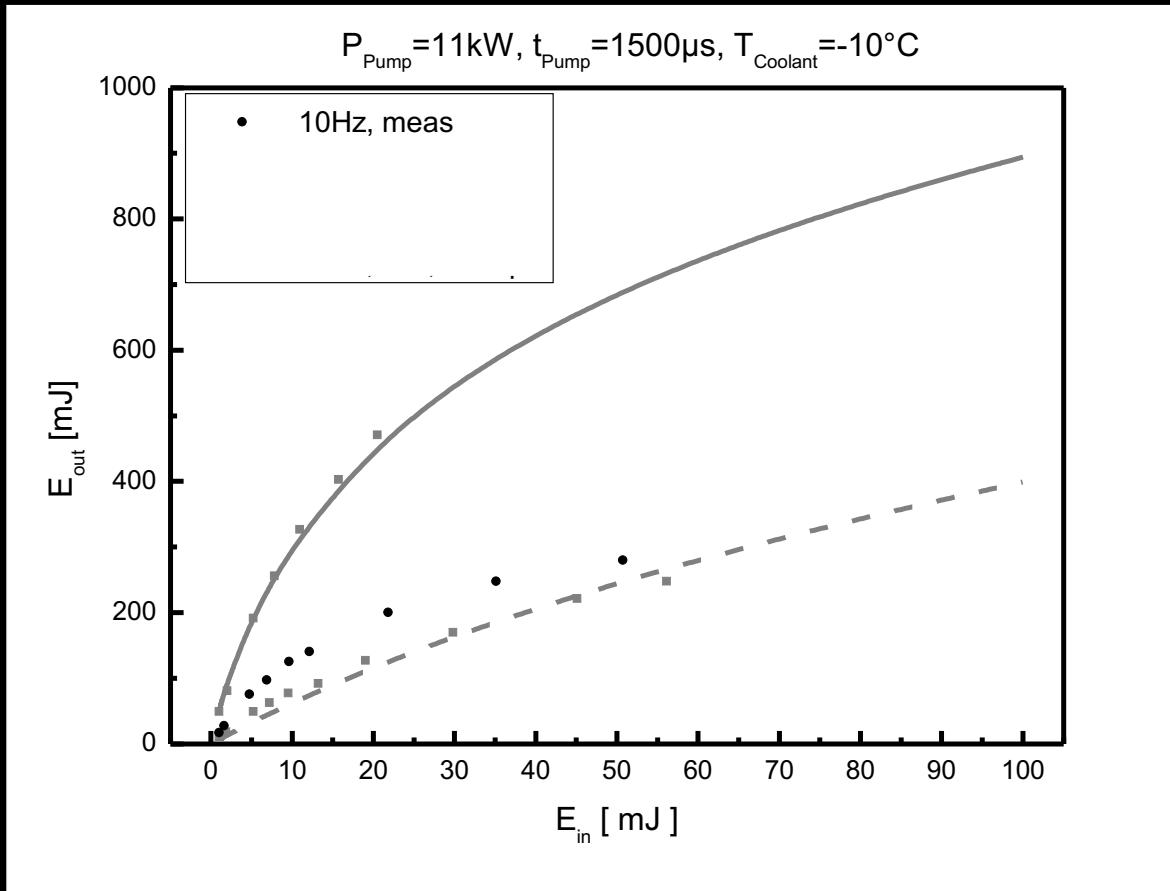
H3 imaging multi-pass - new chiller - 6mm x 2% dop.



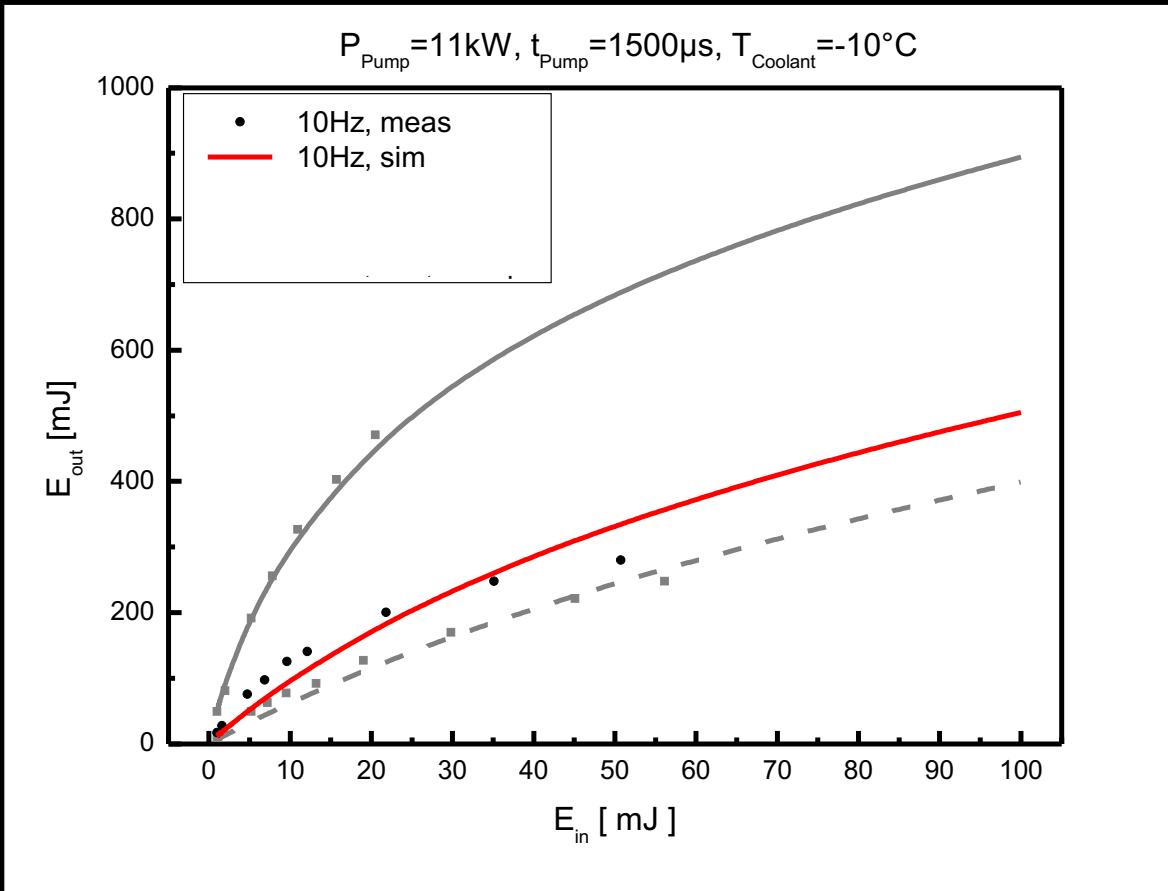
H3 imaging multi-pass - new chiller - 6mm x 2% dop.



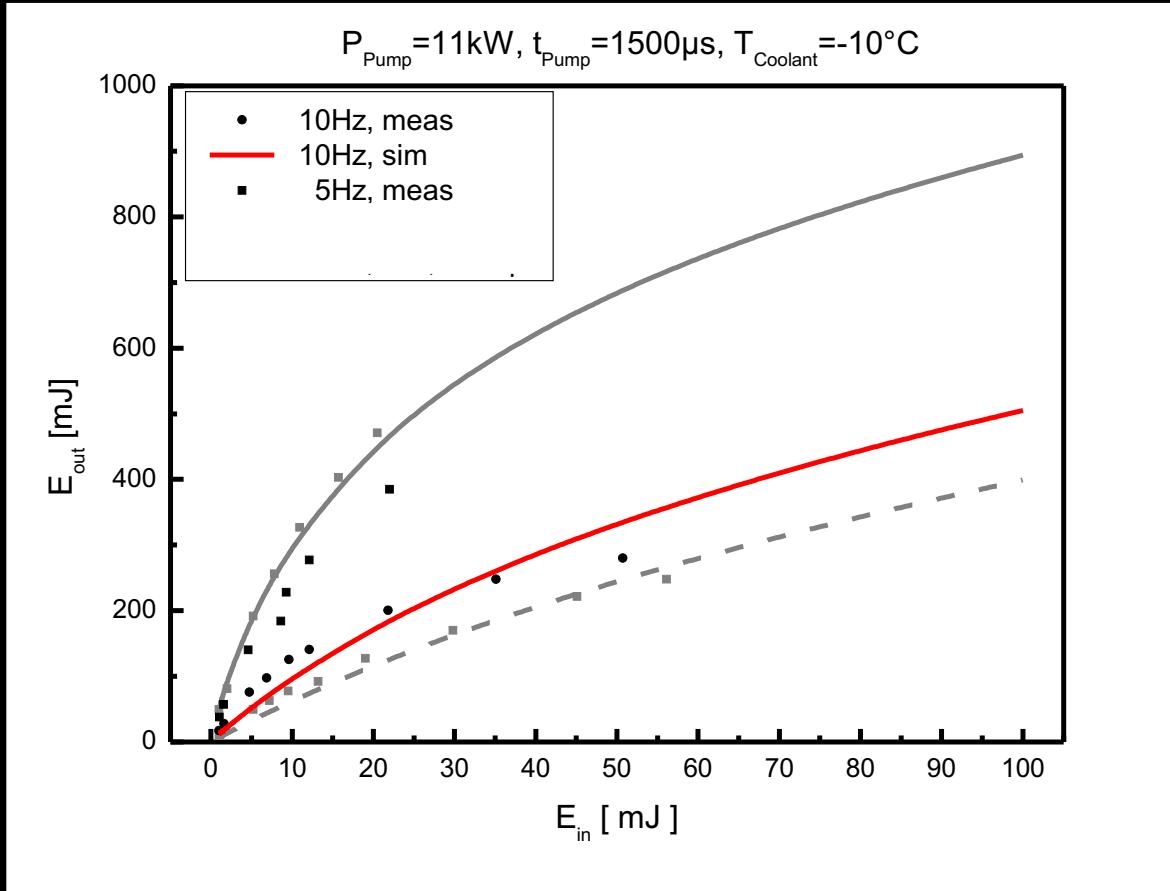
H3 imaging multi-pass - new chiller - 6mm x 2% dop.



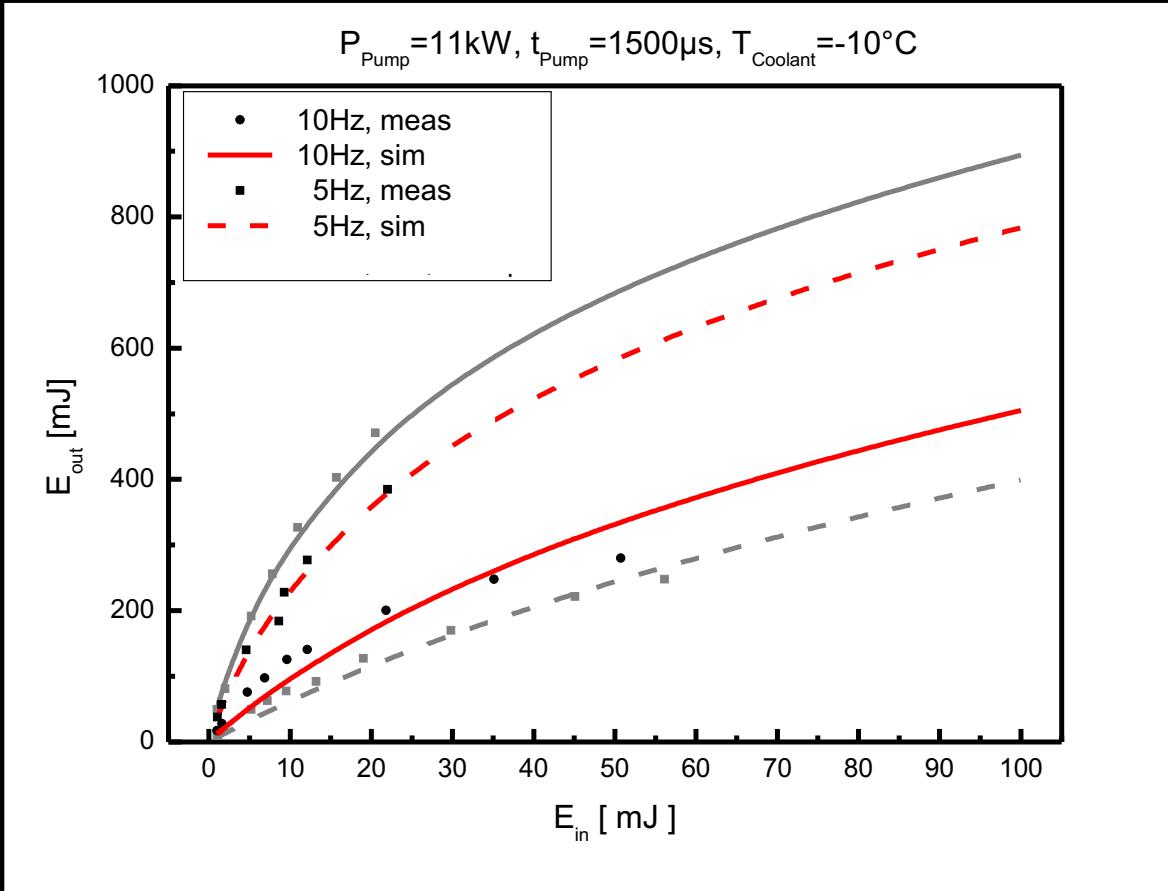
H3 imaging multi-pass - new chiller - 6mm x 2% dop.



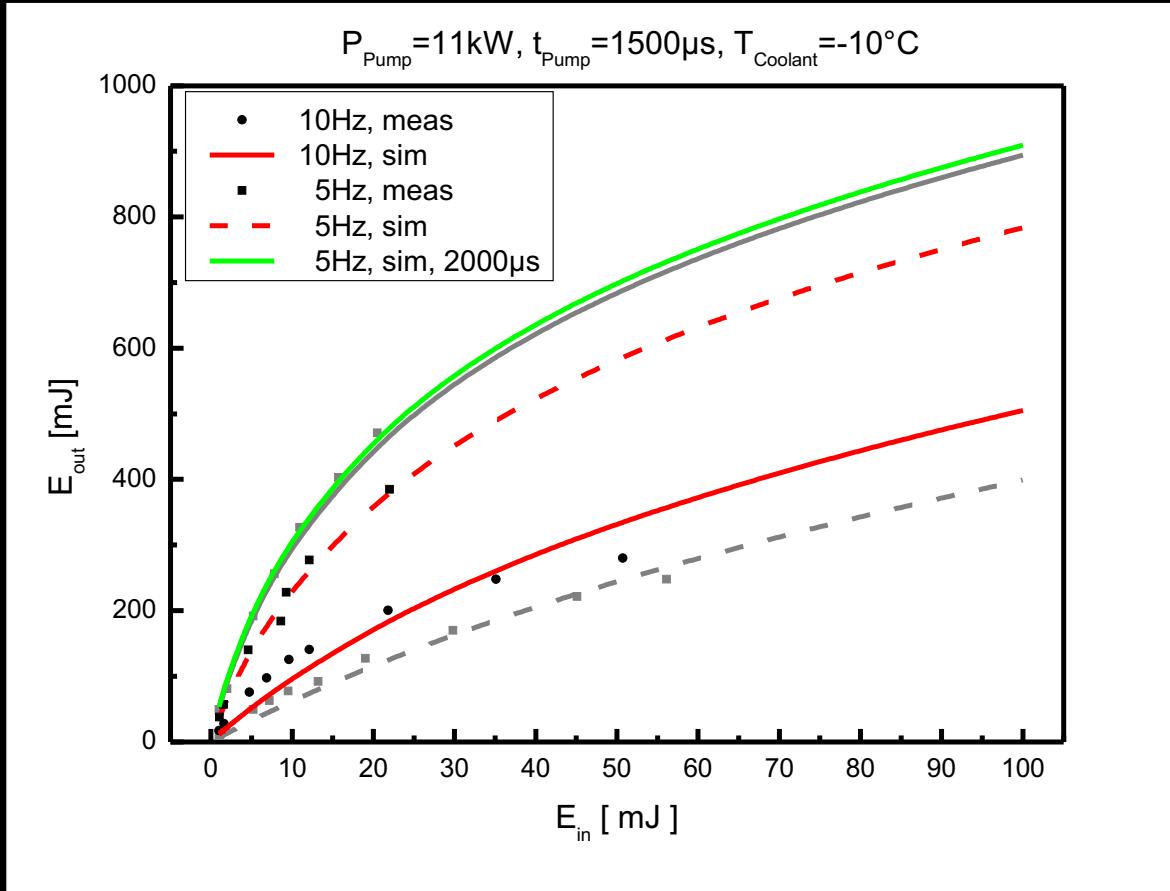
H3 imaging multi-pass - new chiller - 6mm x 2% dop.

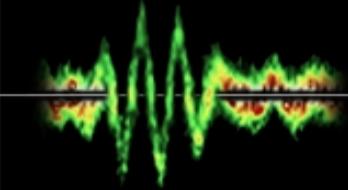


H3 imaging multi-pass - new chiller - 6mm x 2% dop.



H3 imaging multi-pass - new chiller - 6mm x 2% dop.



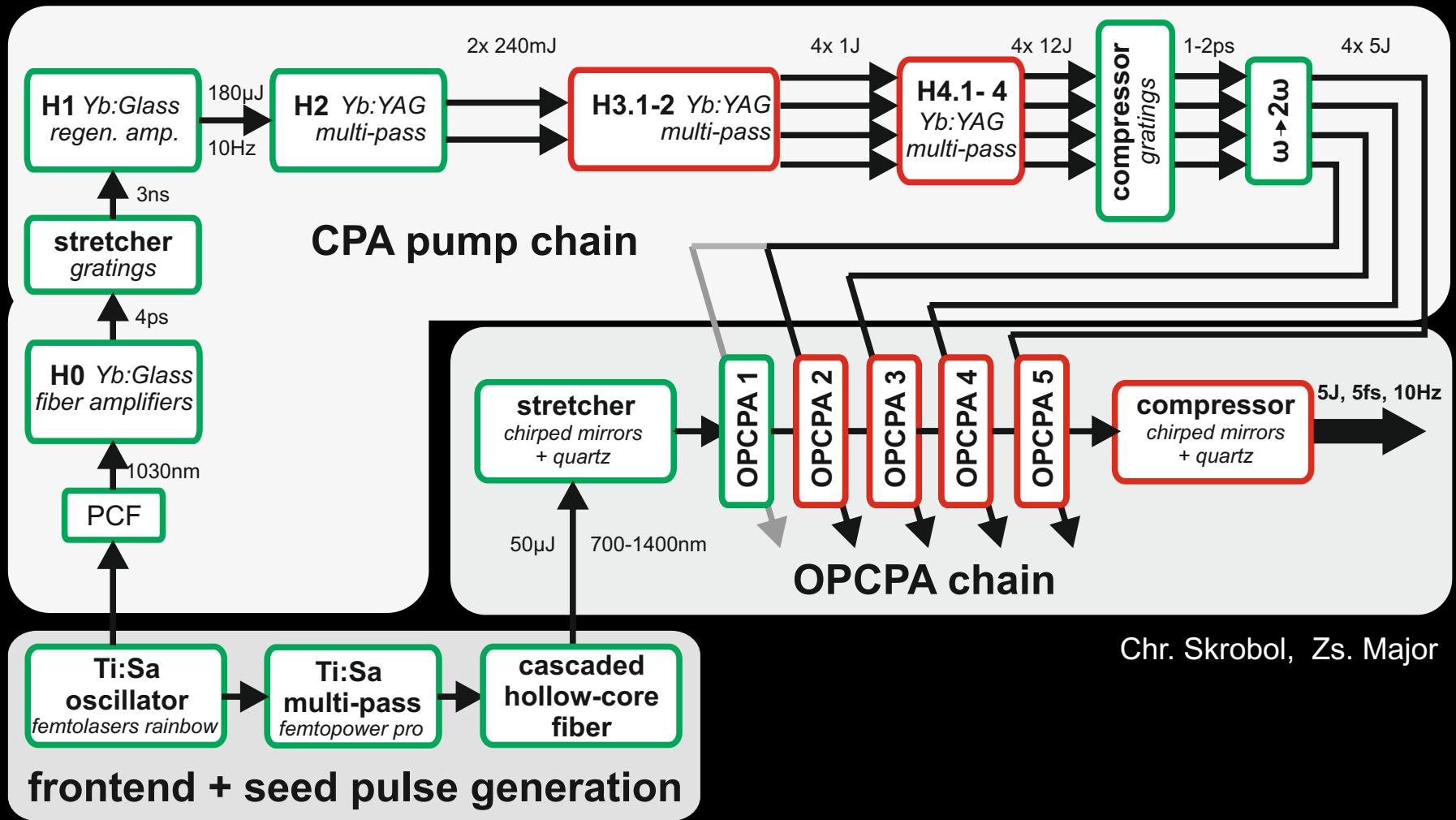


H3 imaging multi-pass - summary

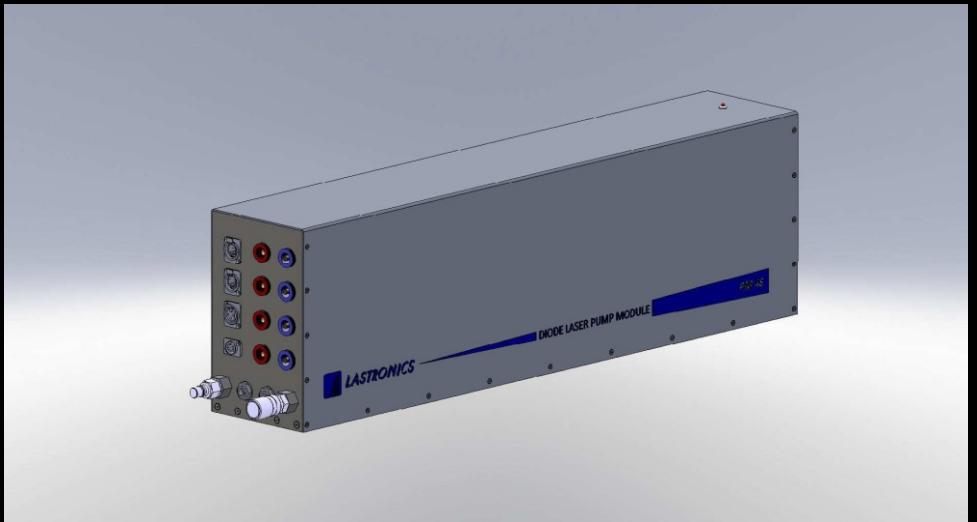
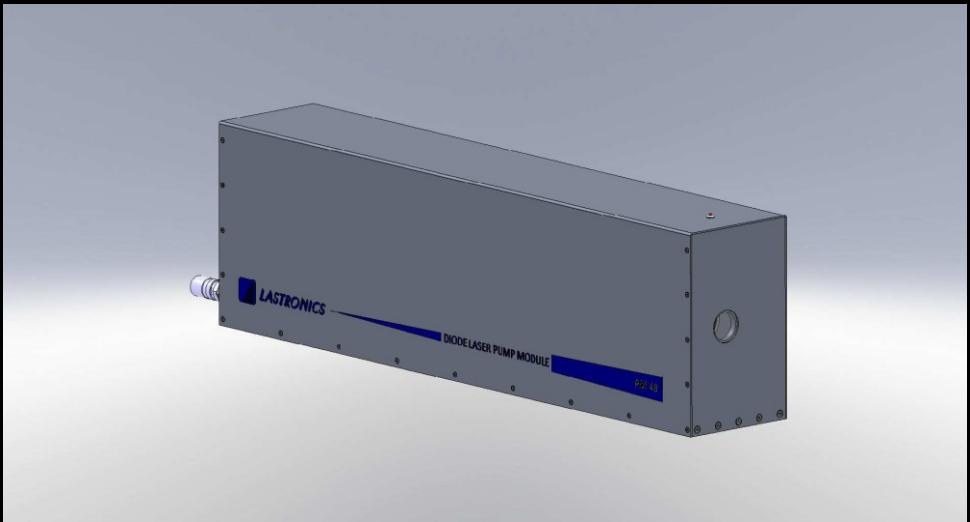
- whole system works in principle
- 1.2J output energy could be achieved in up to 2Hz
- cooling down the crystal improves amplification a lot
- 1J operation @ 5Hz should be possible

overview

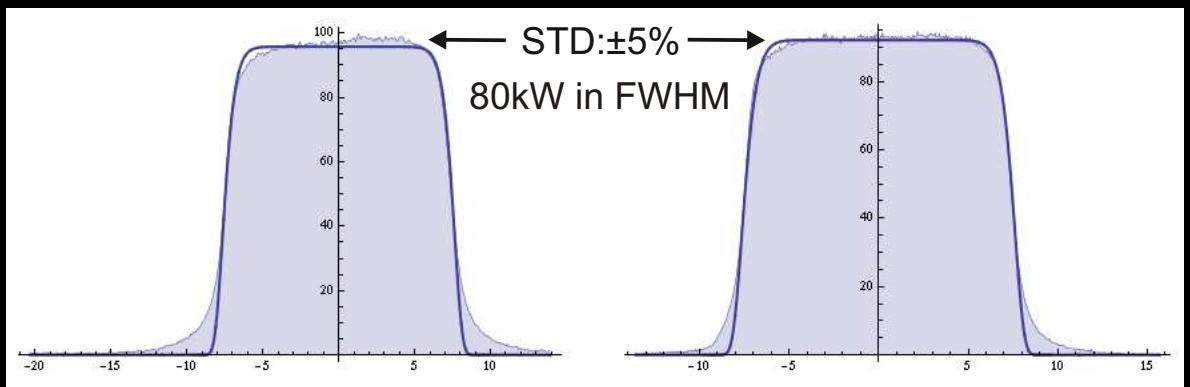
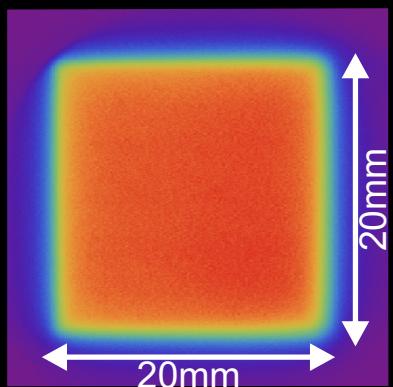
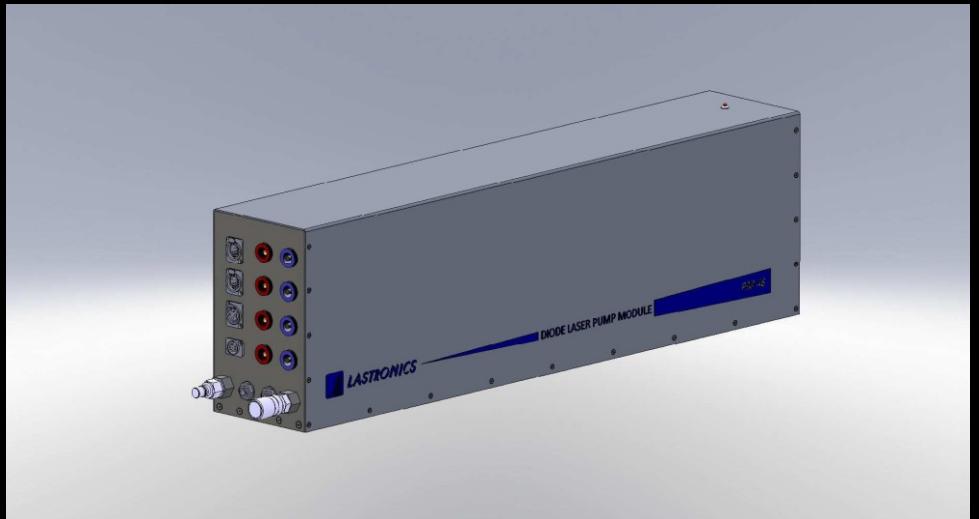
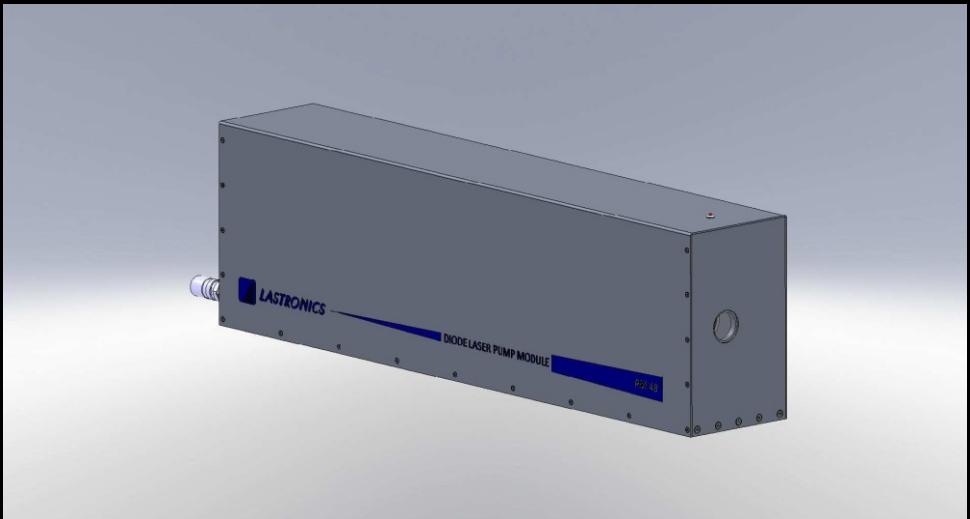
Chr. Wandt, S. Klingebiel



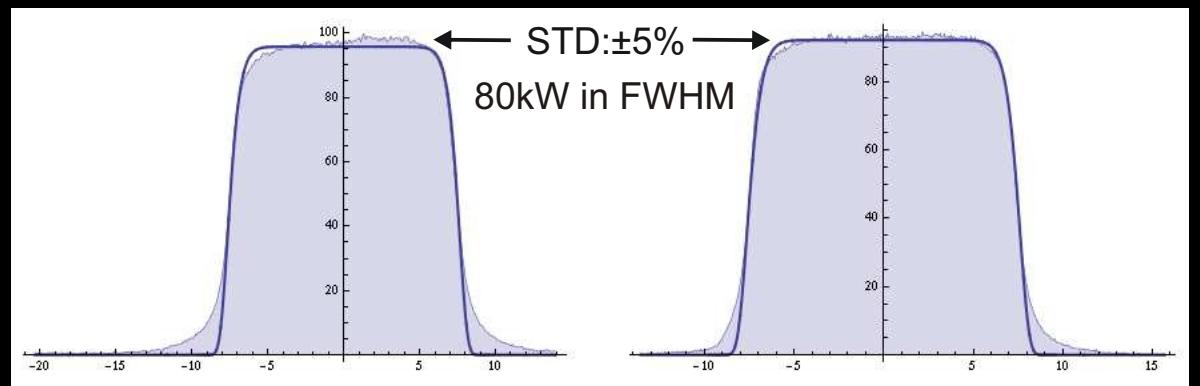
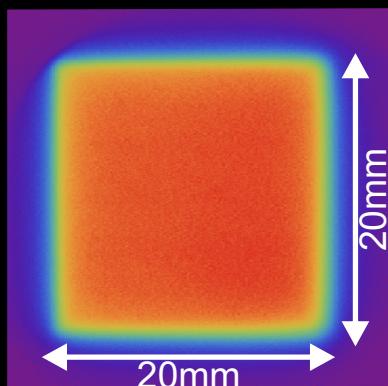
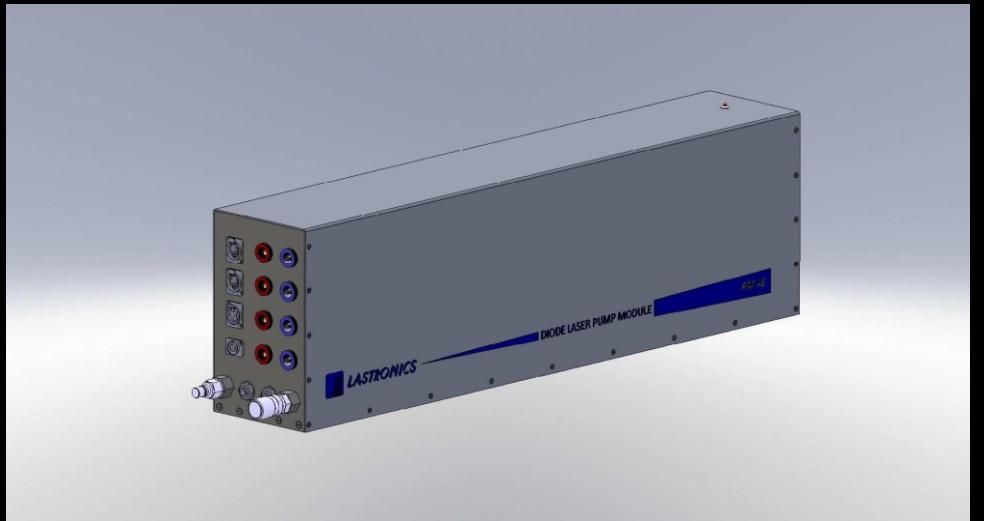
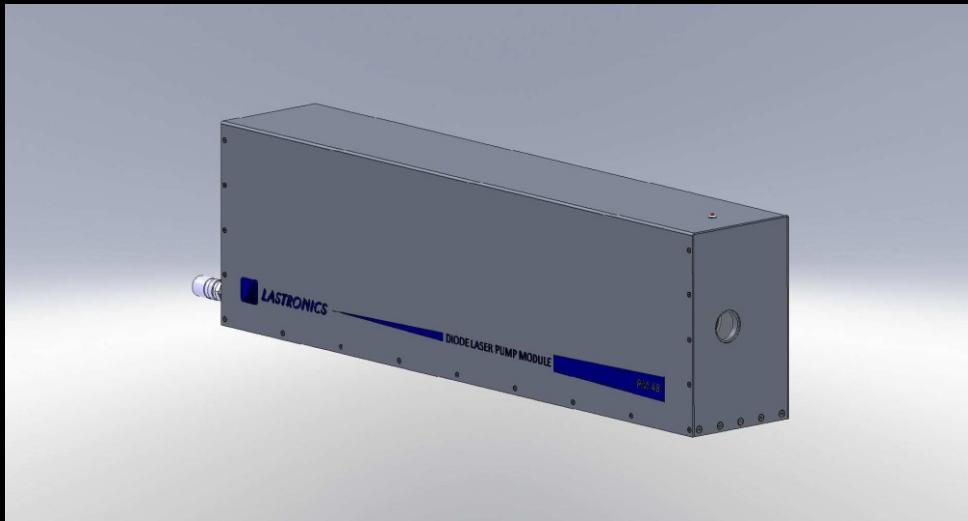
H4 - pump modules



H4 - pump modules

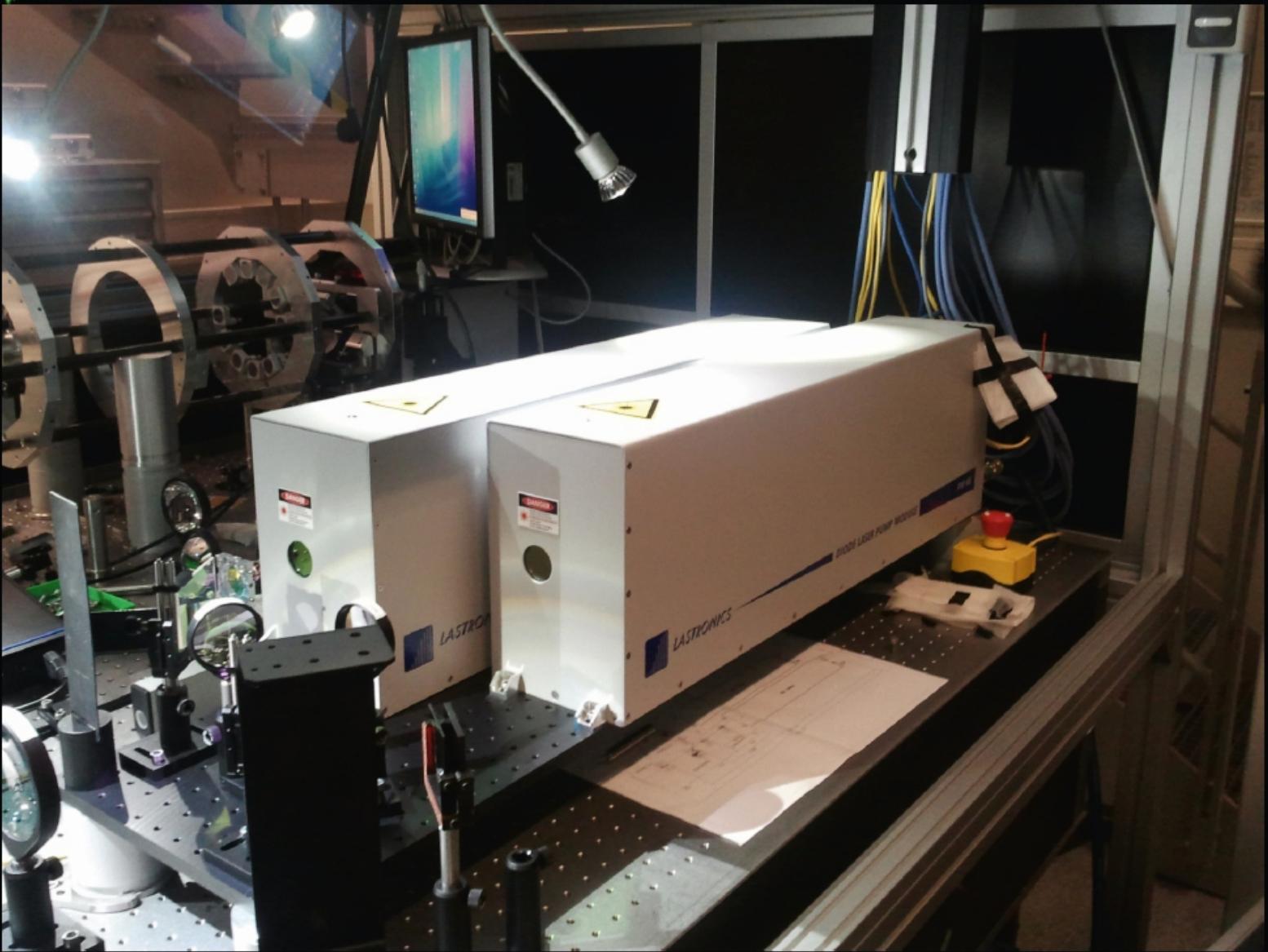


H4 - pump modules

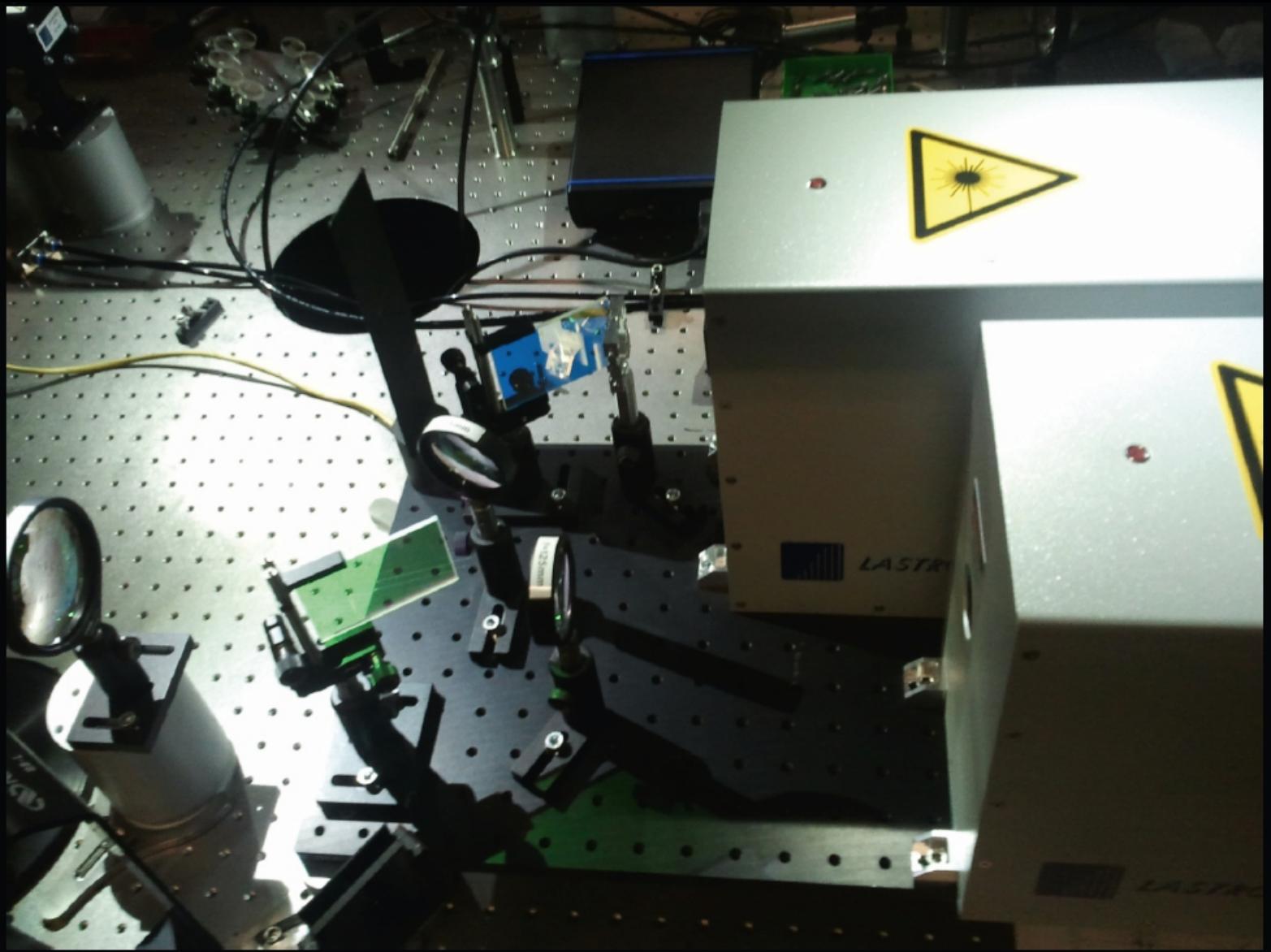


- **4pass** pumping @ $20 \times 20\text{mm}^2$ @ 120J, 2% dop. x 6mm crystal
- 10+x passes should allow for 12J output

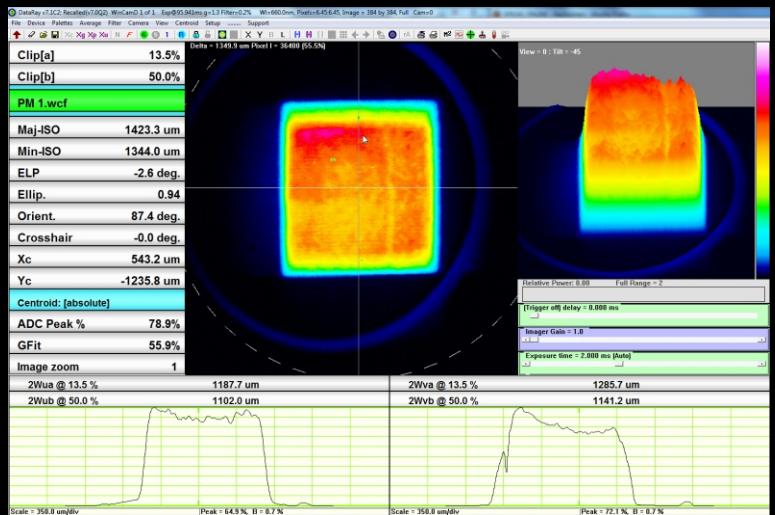
H4 - pump modules



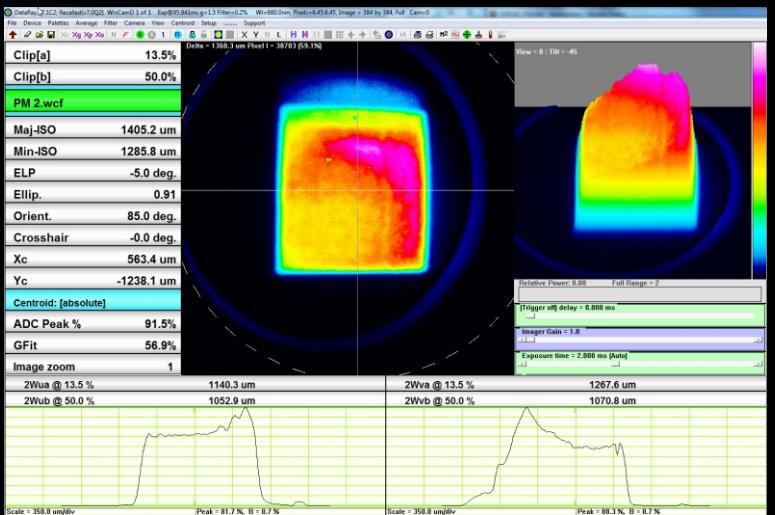
H4 - pump modules



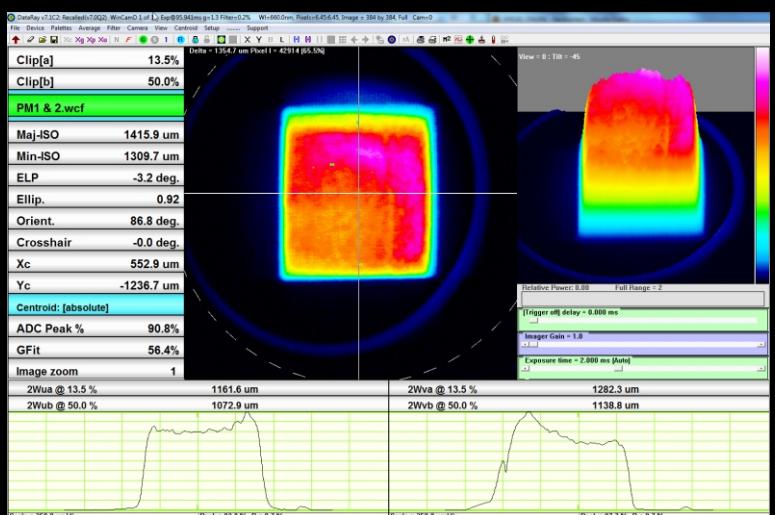
H4 - pump modules



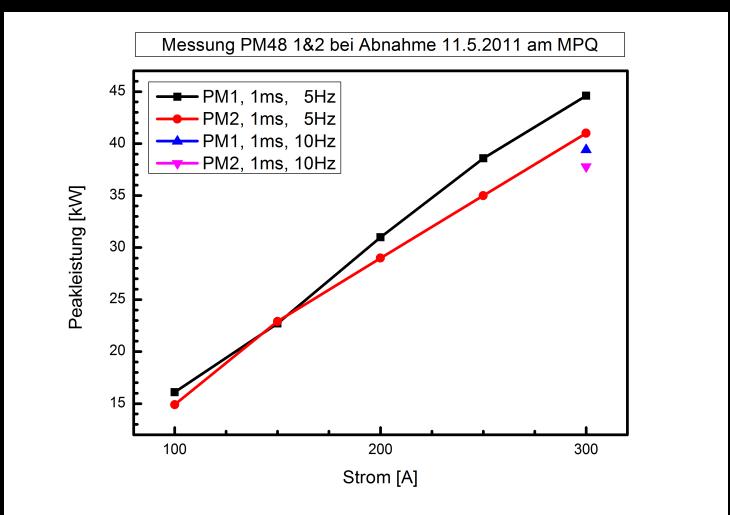
PM 1



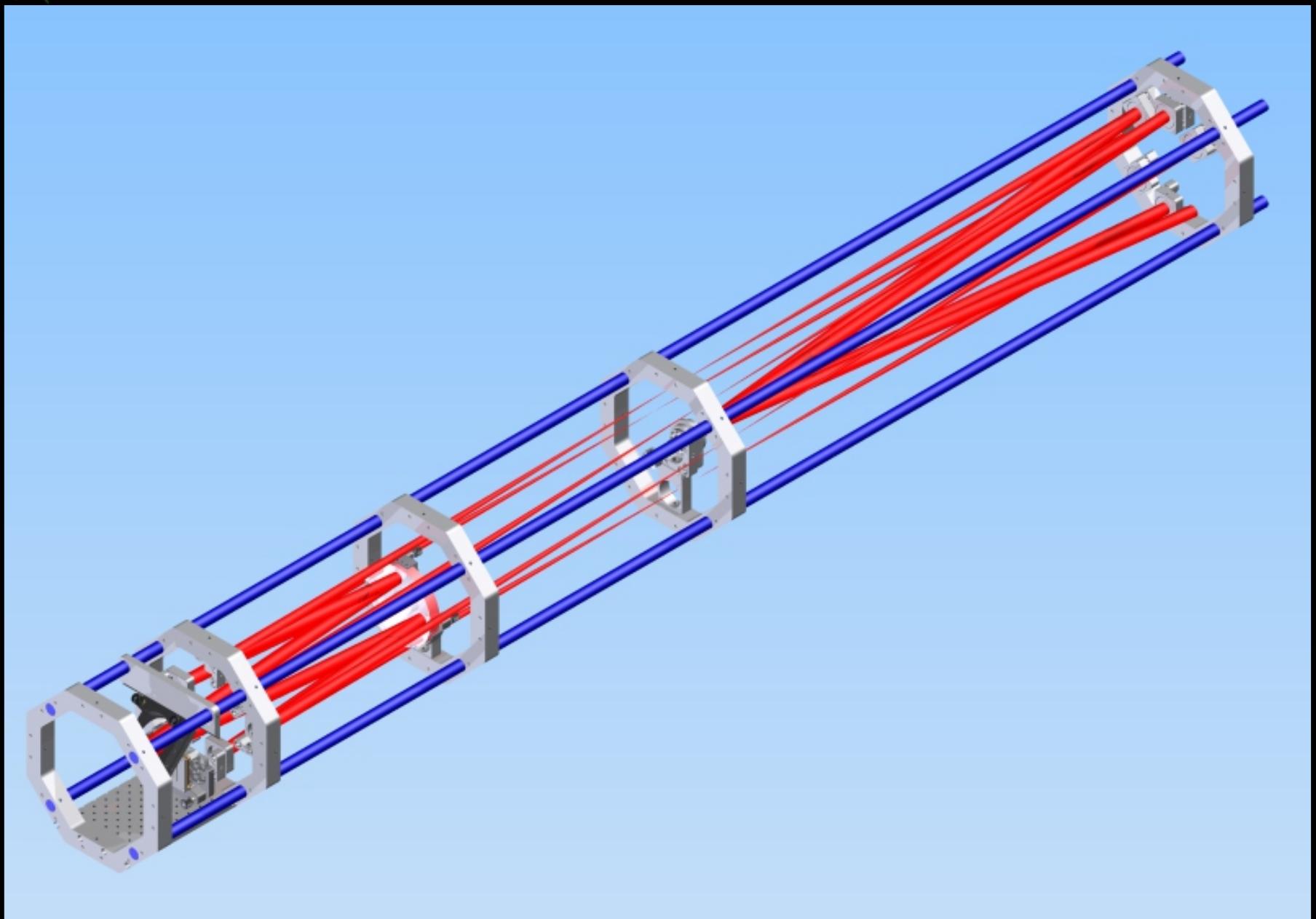
PM 2



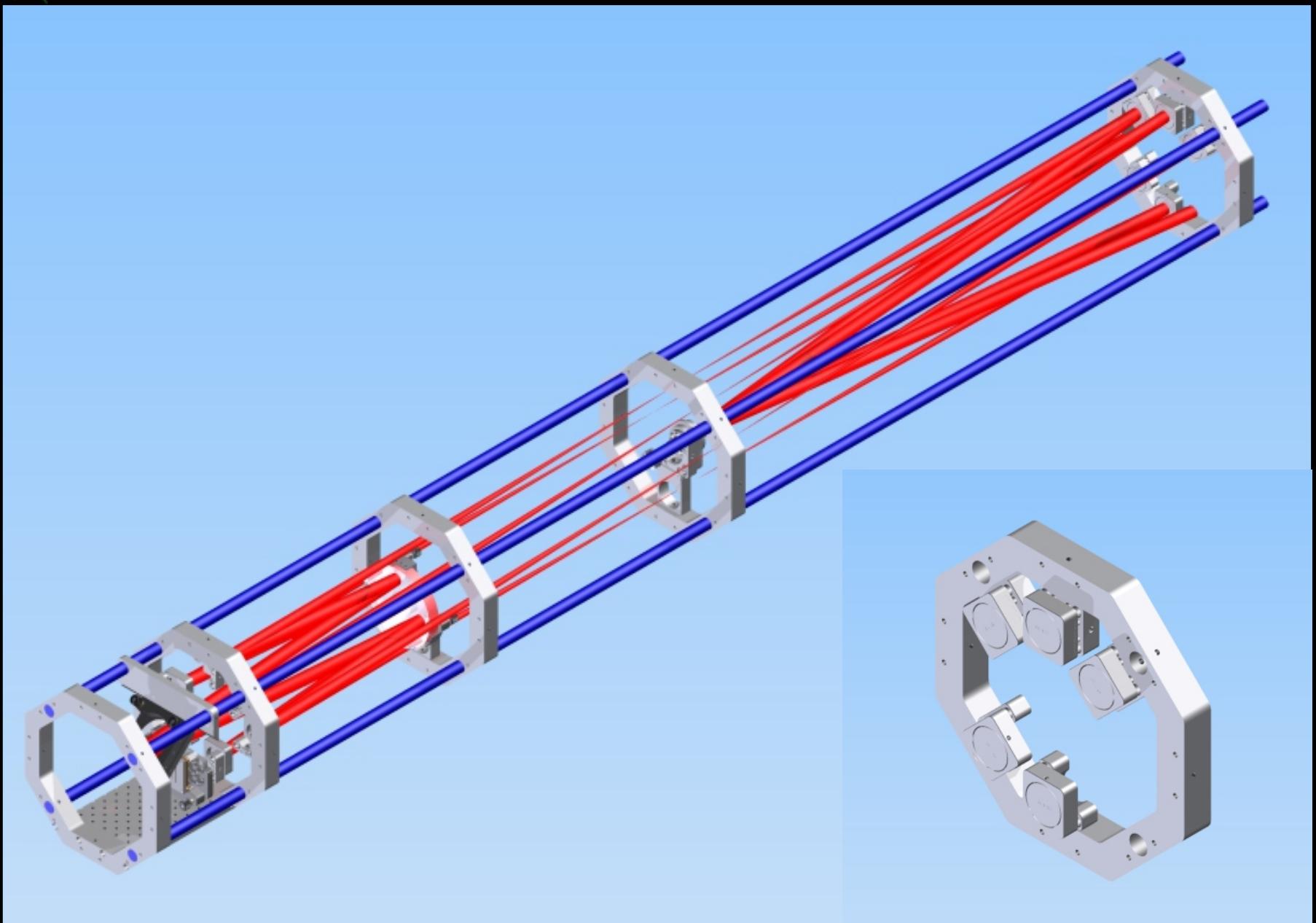
PM1&2

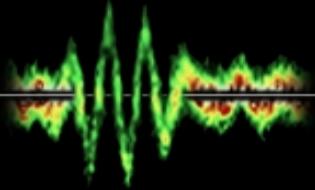


H4 - concept



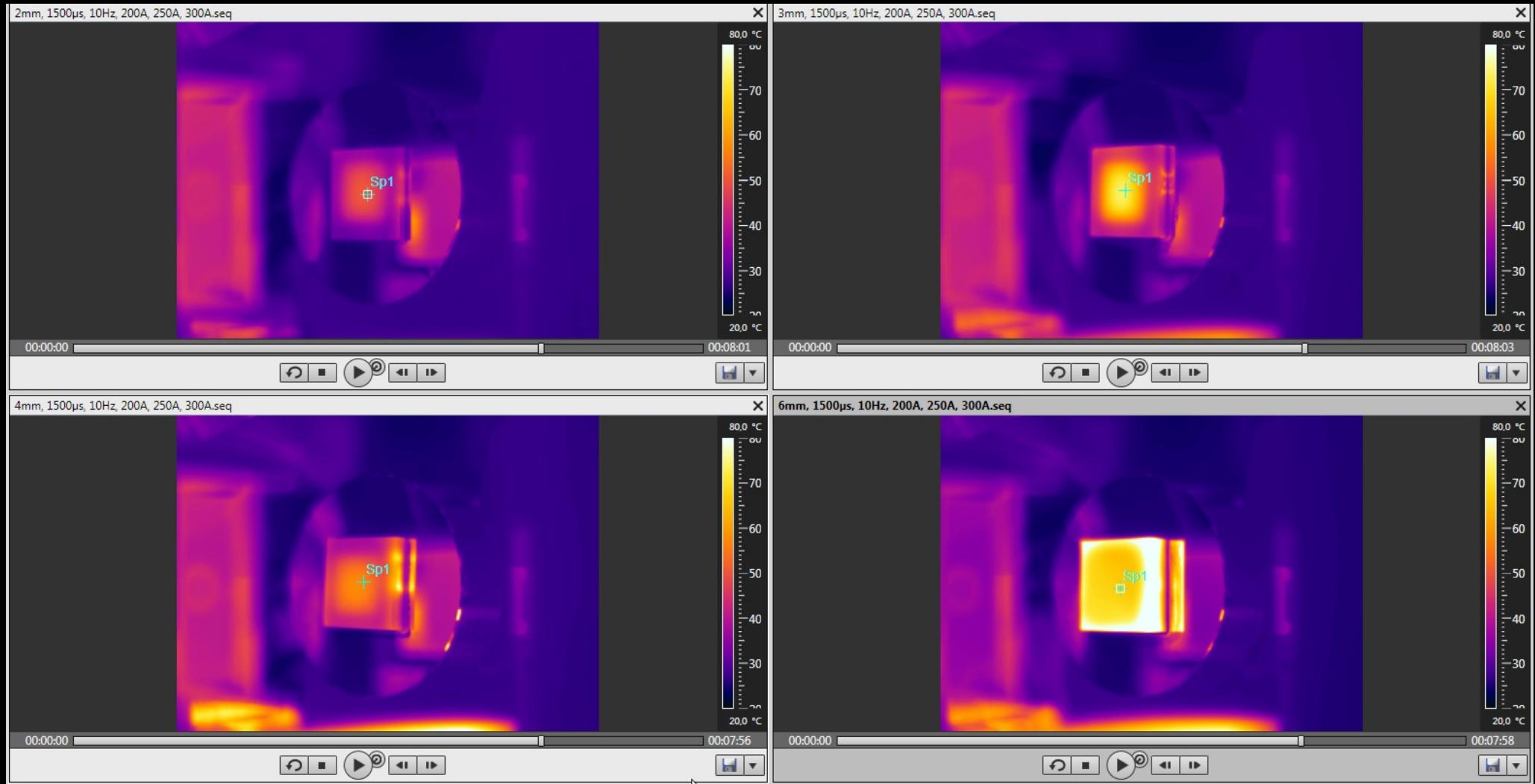
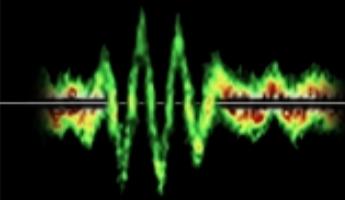
H4 - concept



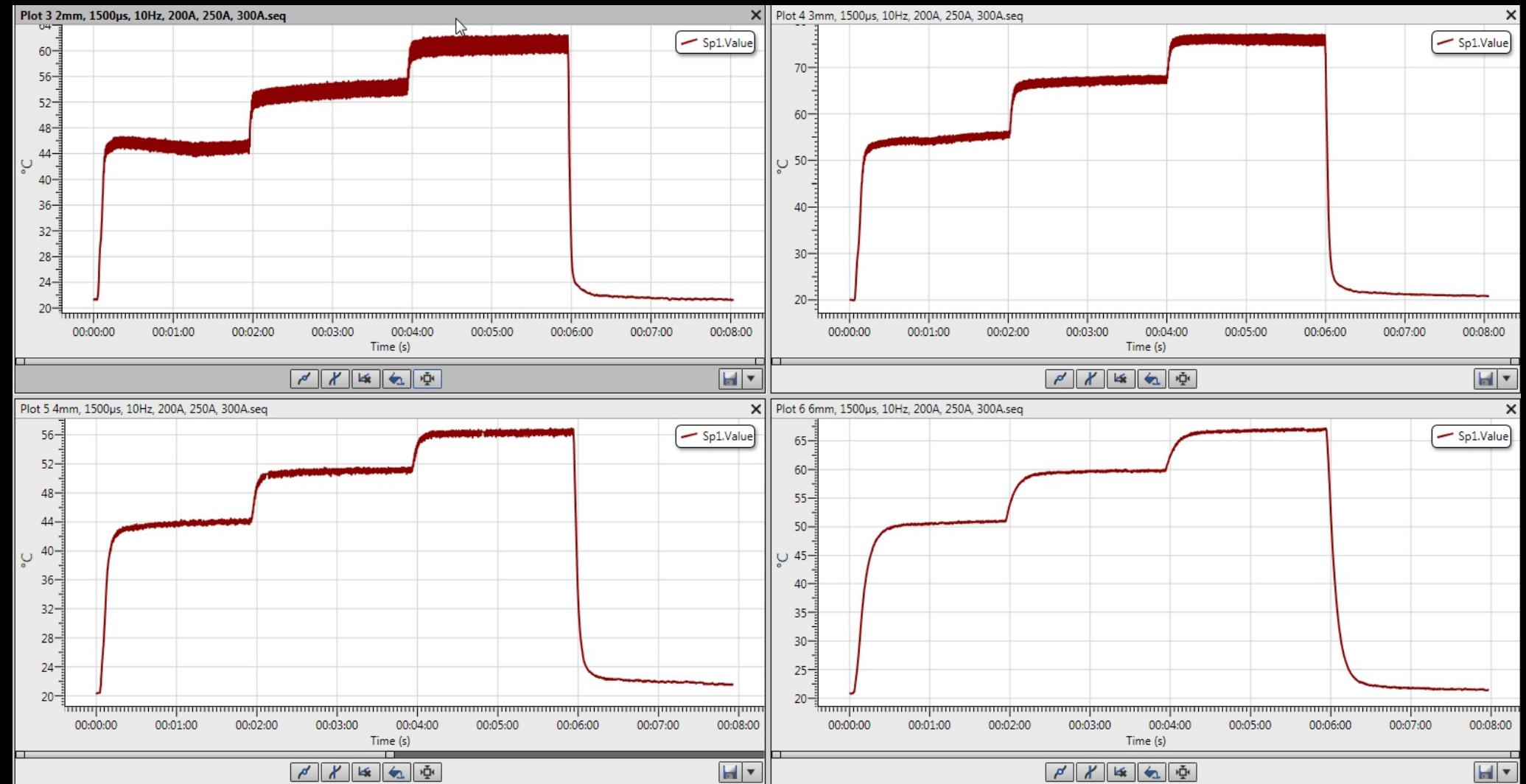


Thank you for your attention

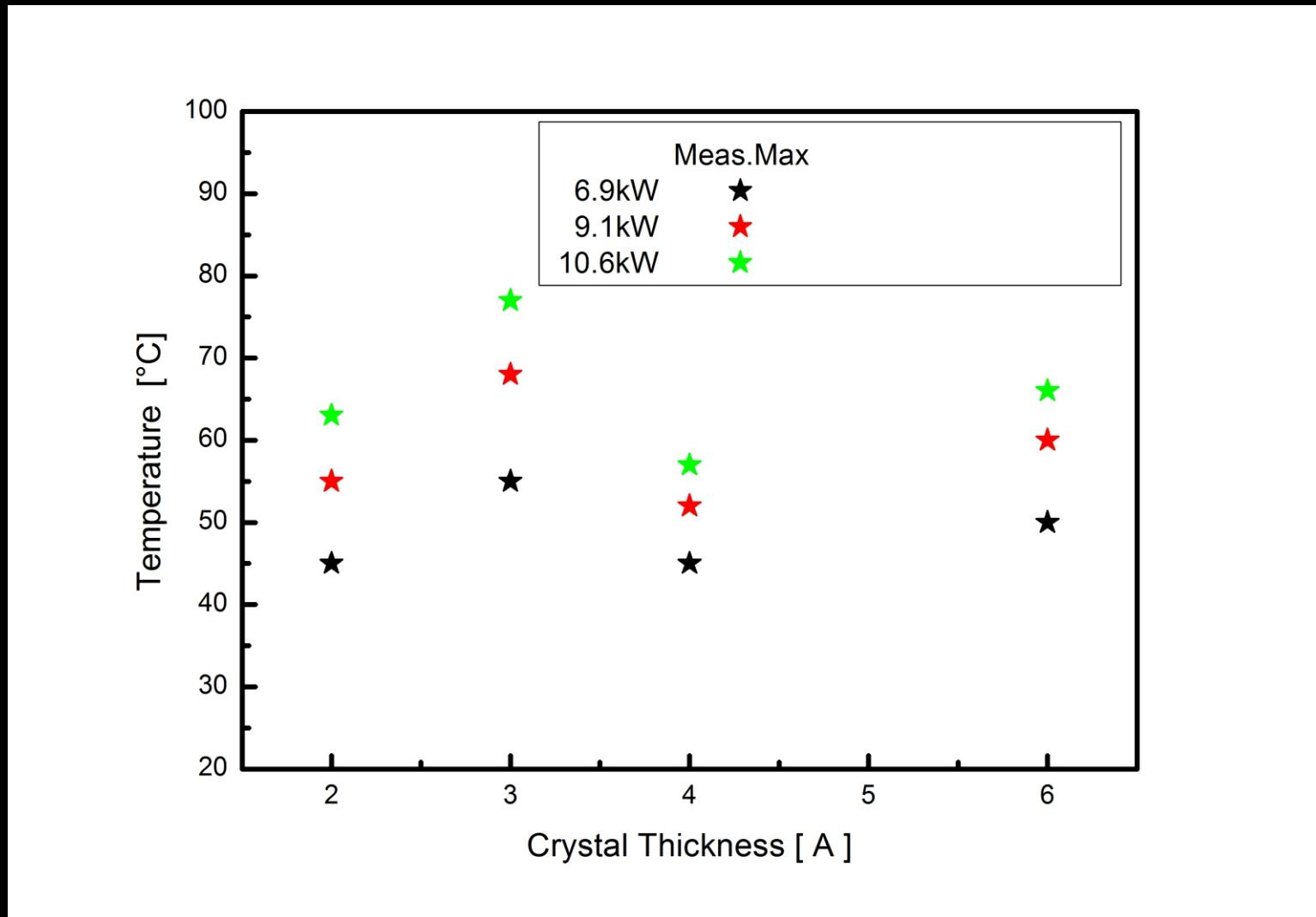
H3 imaging multi-pass - vacuum tests - temperature



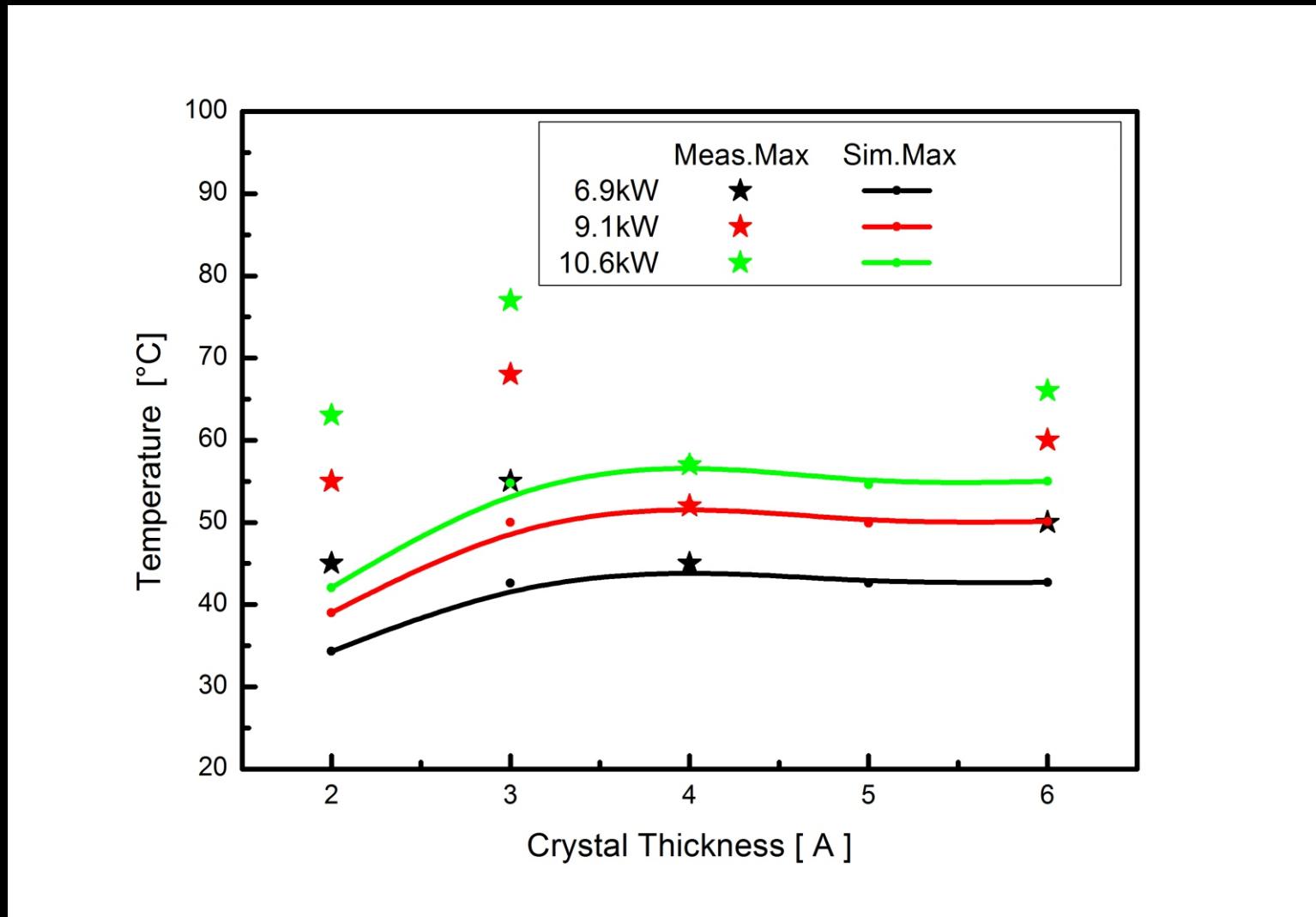
H3 imaging multi-pass - vacuum tests - temperature



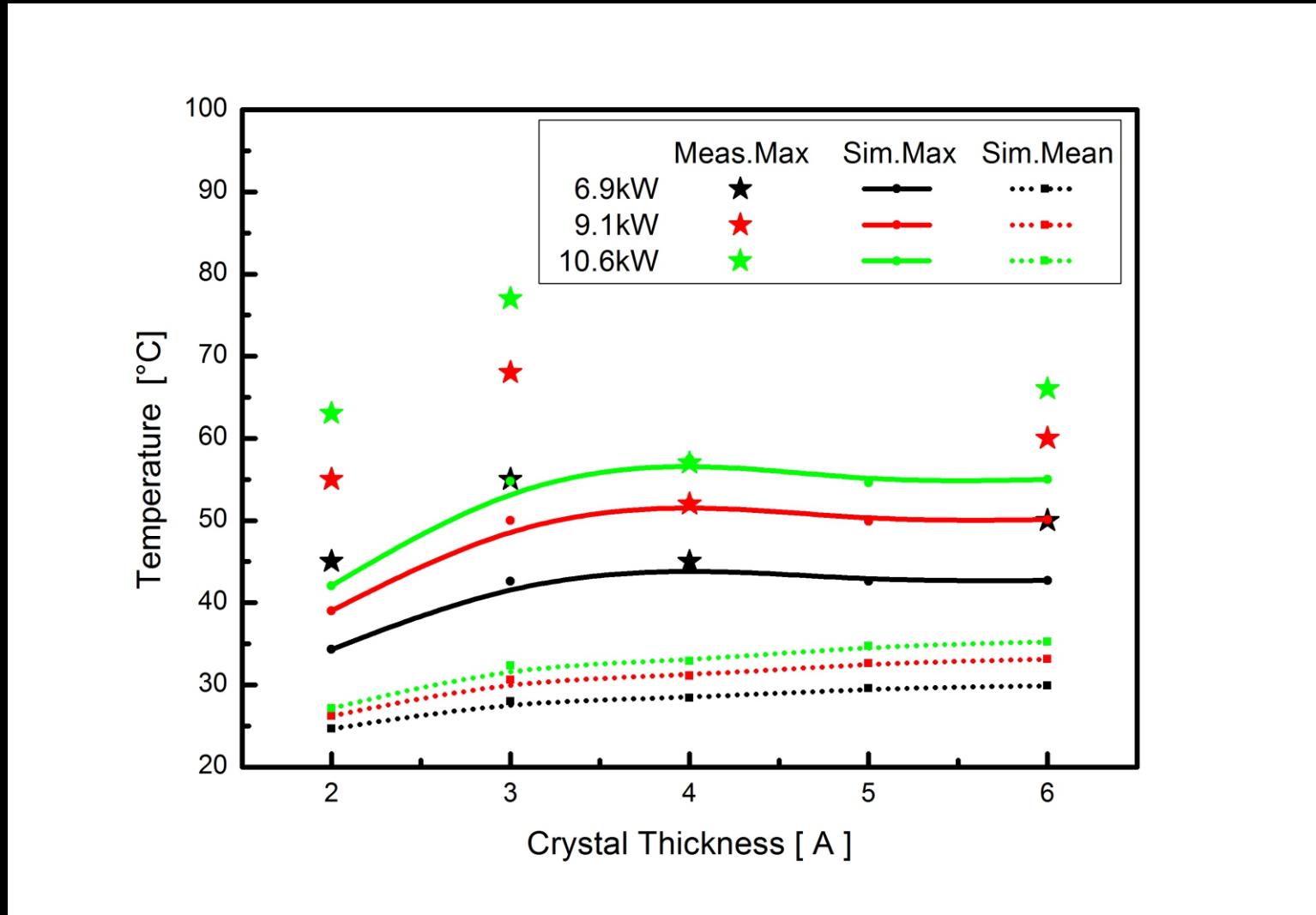
H3 imaging multi-pass - vacuum tests - temperature



H3 imaging multi-pass - vacuum tests - temperature



H3 imaging multi-pass - vacuum tests - temperature



H3 imaging multi-pass - vacuum tests - temperature

